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A National Environmental/Energy Workforce Assessment. Post-Secondary Education Profile: Pesticides

National Field Research Center, Inc, Iowa City, IA

Prepared for

Environmental Protection Agency, Washington, DC

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16. ABSTRACT

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs — their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates.

Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

Phase I of the study assessed the workforce needs (manpower needs) for pollution control and abatement in the United States for the five-year period of 1976 through 1981. Phase III, which will be available in September 1979, will offer recommendations, curriculum changes, and modifications that appear necessary to assure a properly trained national environmental workforce

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Water Pollution Solid Wastes Potable Water Pesticides Radiation Noise Pollution Energy Manpower	Environmental Engineering Environmental Health Environmental Education Environmental Protection Pollution Control Instruction Schools Education Ecology	National Environmental/Energy Workforce Assessment	

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Post Secondary Education Profile

PESTICIDES

Phase II
Of A National Environmental/Energy Workforce Assessment

Conducted by:

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NATIONAL TECHNICAL
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NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

PESTICIDES

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC.

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Gratitude must be expressed to the many individuals and organizations from the private sector who were most generous in their contribution to this project. Their openness and responsiveness reflect their concern regarding the training of our environmental workforce and their critical role in that effort.

REVIEW COMMITTEE

A special word of acknowledgement is extended to the following people who graciously gave of their time, knowledge and experience in order to review and comment on the information included in this volume. The efforts of this national committee were particularly insightful, and in general have been incorporated into the final report.

It must be pointed out that in all cases the individuals acknowledged below were asked only to review and comment on the material contained in the volume and to express their views regarding the representativeness of the material presented. They were not asked to endorse either the volume or the study in general, and the inclusion of their name on this list should not be considered an endorsement since such was not the intent.

In light of numerous responsibilities, it is especially important to note that these persons responded within very strict time constraints. Such a pattern reflects positively on both the individuals and the institutions and organizations which they represent.

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FOREWORD

Information for this report was largely compiled from on-site interviews with professionals in post-secondary institutions throughout the United States. On-site interviews were supplemented by telephone and/or mail contact to clarify and revalidate the data. This report presents a summary of programs in junior colleges, vocational/technical training institutes, community colleges, four-year colleges, and universities as well as other training institutions. Programs are representative of all levels from academic certification through doctoral degrees. The environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater and energy were surveyed.

This study was conducted for the United States Environmental Protection Agency by the National Field Research Center, Inc. of Iowa City, Iowa, with field offices located in Atlanta, Georgia; Denver, Colorado; and Washington, D.C.

NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

PESTICIDES
SUMMARY

A. STATES, INSTITUTIONS, PROGRAMS AND DEGREES

Pesticide- and toxicology-related training programs were reviewed in twenty-one states and in twenty-six academic institutions. Three programs included in the study were considered non-institutional and are not degree-granting. Considerable variance in size, description, and extent of topic coverage was observed. The thirty-four programs surveyed range from the certificate and diploma level to advanced degree programs; they are offered by institutions such as community colleges, private colleges, and state universities. The following table illustrates the breadth of geographic coverage represented in this profile. A number of options are offered at more than one academic level, which allows a student to pursue those topics to whatever extent she/he chooses.

TABLE
STATES, PROGRAMS, DEGREES

Degree	Number of Programs	States
Associate	4	GA, FL, NC, NY
Certificate/Associate	2	LA, NE
Bachelor	8	CA, DE, GA, NC, NH, NM, TX
Bachelor/Masters	1	OR
Bachelor/Masters/Doctoral	4	CA, NJ, PA, UT
Masters	5	CA, MD, MS, TX
Masters/Doctoral	5	GA, MA, NY, OH, PA
Doctoral	2	OH, IA
TOTAL	31	20

The three remaining non-institutional programs are offered in Maine, Florida, and Nebraska, and none offers any form of academic credit.

B. ENROLLMENT STATISTICS AND GRADUATES

Although a number of pesticide/toxicology programs report they have no need for formalized recruitment, the majority employ one or several techniques. Examples of such include: forwarding descriptive materials to other institutions, making personal responses to prospective students' inquiries, making contacts at national meetings and in industrial settings, and maintaining registry in the Peterson's Guide to American Colleges and Universities.

Statistics show a high of 95 percent of the associate level entrants' coming from within the state, as compared to a low of 41 percent at the doctoral level. The percentage of women enrolled in these programs varies at all levels from 11 to 50 percent.

The following two tables depict the enrollment profiles and average number of graduates for the past three years, by degree level, for pesticide and toxicology programs respectively, which were reviewed for Phase II. Also summarized are the apparent enrollment trends by degree, over the past three years.

TABLE

PESTICIDE ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Enrollment Change by Program Up	Down	Stable
Associate	147	1	46	1	0	6
Bachelor	374	11	107	7	0	5
Masters	236	4	51	5	0	6
Doctoral	71	0	11	2	0	3
TOTAL	828	16	215	15	0	20

TABLE

TOXICOLOGY ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Enrollment Change by Program Up	Down	Stable
Associate	0	0	0	0	0	0
Bachelors	42	0	22	0	0	1
Masters	43	1	18*	1	0	0
Doctorate	72	0	14*	3	0	2
TOTAL	147	1	54*	4	0	3

*Estimated graduate figures

C. FACULTY

Pesticide and toxicology programs which are described in this profile are served by a total of 620 full- and part-time faculty. Fifty-nine percent, or 369 of these, are part-time and the remaining 40 percent have full-time involvement. Even though faculty responsibilities may vary in substance and extent among teaching, research, and administration, it is useful to compare the total faculty support to the total number of students counted for full-time enrollment, i.e., 926 students.

Pesticide/toxicology program officials responded to the question, "How do you keep current in your field?" most often by identifying affiliations with professional associations, including participation in their regional and national meetings and conferences. Other means of keeping abreast of the field include: carrying out research, reading current professional papers and other relevant literature (including journals), keeping contact with colleagues at other institutions, teaching courses, consulting, and working in agricultural extension services.

D. CURRICULA

The pesticides certificate/associate programs focus on pest control technology, and represent several approaches to the field, including agricultural pest control, urban pests management and plant protection. Bachelor level programs are nearly evenly divided between the classifications of entomology and pest management. Graduate curricula surveyed are also predominantly classified as entomology and pest management programs, though offering more advanced and specialized courses. Of the seven toxicology programs surveyed, one is offered at the bachelor level, with a concentration in environmental toxicology. The remaining six toxicology programs are offered at the graduate level, and within the majority of these programs, the student has a choice of concentrations (i.e., environmental toxicology, neuro-behavioral toxicology, or radiation toxicology).

In some cases, students are able to receive on-the-job training through a co-op program. An internship/applied study term is available in twelve of the thirty-four programs visited (see TERMINOLOGY).

Faculty members were asked to identify time constraints which apply to making changes in a single course, as well as the time necessary to implement a change in a program (see TERMINOLOGY). Courses are commonly added under the title of "Special Problems" or "Special Topics" until they are channeled through the appropriate ranks for approval and inclusion in the catalog. The date of catalog publication often determines how quickly both course and program changes may take place. Still another built-in feature of many programs is that of the "individualized program", wherein an institution may informally offer students a number of unconventional options. Most faculty responses show that changes in both courses and in programs require from one month to one year to establish officially.

There is a need to develop curriculum aids such as micro-films, audio-visual materials, and tutorial/self-help materials. Another need which was noted was for text materials designed for the intermediate level. It is felt that most existing materials are prepared with either the advanced level class or the very basic class in mind.

With only one exception, the communication skills of pesticide/toxicology students are considered to be deficient. One cause which was cited was a lack of practical experience in writing, so remediation in that institution is taking the form of extensive report writing assignments and essay type examinations. It was thought also that such measures as increasing the time required for earning a bachelor's degree from four to five years, developing and alliance with industry to secure their assistance in identifying graduates' skill priorities, and requiring students to take courses in technical writing all would be helpful in remediation. The responses which were recorded for the question of students' financial management skills were like those regarding communication skills, but much less emphatic. One source felt the quantified/scientific nature of these fields cause these math related skills to be sufficient, if not somewhat enhanced.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

Data from Phase II indicate that the most prevelent form of financial assistance to graduate students is the research assistantship, and similar in-house work-study arrangements. The funding is often channeled through the respective graduate schools, or an established center or research body. At the undergraduate level the nature of and availability of financial support is influential on the percentage of students who attend an out-of-state insitution. Most pesticides/toxicology related graduate students at all of the institutions reviewed for Phase II do receive support in one form or another.

Although student support is often tied to public and private monies, other forms of financial support were mentioned by everyone. They include state instructional grants, state and national student loans, Basic Educational Opportunity Grants, research assistantships, fellowships, and scholarships.

F. EMPLOYMENT

The following table shows the employment data of graduates from the twenty-four institutions visited that offer degrees with coverage of pesticides and/or toxicology. Figures were provided by faculty members and were either actual statistics or "best estimates".

TABLE
PESTICIDE/TOXICOLOGY EMPLOYMENT PROFILE - NATIONAL

Degree	Private Sector Industry	Private Sector Consulting	Combined*	Government	Other
Certificate/ Diploma	80%	10%		10%	
Associate	75%	6%		7%	12%
Bachelors	45%	1%	3%	31%	20%
Masters	42%	11%	1%	31%	15%
Doctorate	29%	9%	4%	27%	31%

*Refers to industry and consulting figures collectively in the instances where sources did not break them down.

Contact persons were asked to choose from twenty-three pesticides related or toxicology related occupations, indicating those which they consider their graduates qualified to fill. They were also asked to provide any additional occupational titles which they considered to be appropriate. In some cases, students are qualified to fill many positions which they do not enter historically. The occupations most often cited were:

Degree Level	Occupational Titles
Associate	Pesticide Applicator Pest Control Operator/Inspector/Monitor/Technician
Bachelors	Entomologist* Insect Rearing Specialist* Epidemiologist* Environmental Monitoring Specialist*
Masters	Pest Control Monitor* Regulatory Specialist Pest Control Consultant

Doctorate	Teaching - Research -	Extension/University
	Regulatory	Supervisor/Specialist

*Refers to both the Bachelors and the Masters qualifications

PROJECT BACKGROUND

Photo reprinted from the University of Wisconsin, Madison Oceanography and Limnology Catalog

PROJECT BACKGROUND

OVERVIEW:

In late 1975, Congress acknowledged the growing national concern for the preservation and conservation of our national resources with a direct inquiry into the availability and readiness of our environmental workforce. That inquiry has taken the form of a three-year, three-phase National Environmental/Energy Workforce Assessment, currently being conducted by National Field Research Center under the direction of the U.S. Environmental Protection Agency. In keeping with the objective of the assessment, this three-phase national effort directs itself at environmental/energy workforce needs, national educational preparedness, and the functional relationship between the two.

PHASE I:

Phase I of the National Environmental/Energy Workforce Assessment focused upon the development of "workforce demand projections" through 1982 for all public environmental agencies. This on-site assessment, which was carried out in all 50 states, Puerto Rico and the Virgin Islands, culminated in a numerical profile of the growth patterns and workforce needs at the national and state levels. Stratification of the overall definition of "environmental occupation" into seven distinct vocational areas enhanced even further the applicability of the results. In addition to this public sector workforce assessment, Phase I included an overview analysis of private sector needs (through an adjunct mail survey of selected businesses and industries) and a brief review of selected environmental educational programs.

Phase I was completed in May, 1977. The 70-volume final report included:

* National Abstract	(1)
* National Legislation	(1)
* Regional Assessments	(10)
* State Assessments (including D.C., VI and PR)	(53)
* Business and Industry Assessment	(1)
* National Summary	(4)

PHASE II:

Phase II of the National Environmental/Energy Workforce Assessment was structured around an intensive on-site inventory of representative environmental educational offerings on a national scale. The primary objective of this project has been to collect and aggregate data on training and educational programs in both the post-secondary education field and in the private sector and to do so by environmental area. Specifically, the study was designed to provide an overview of environmentally related post-secondary education programs, their program structure, representative course offerings, employment history of the graduates, and the faculty structure. Additionally, information was to be collected on program requirements and program projections.

Initially, opportunities to nominate programs for inclusion in this on-site review process was given to the Environmental Protection Agency and its program officers and regional personnel both through the

Project Officer and via direct mail requests; all state departments of education; state environmental agencies and selected media-specific associations. These nominations were supplemented by a direct review of institutional catalogs, information obtained during the first year's on-site activities, and a review of other published sources of information regarding degree programs in environmental areas. These sources are included in Appendix III - Selected Bibliography.

Following their initial development, the lists of nominees were forwarded to the program officers for suggestions regarding additions or deletions. Next, letters were written to those nominated institutions seeking their support and cooperation in the on-site review process. Several programs, some of which were highly recommended, declined the opportunity to participate giving reasons varying from lack of time to the fact that the program being inquired about no longer existed, to outright refusal to cooperate with any government study. These institutions were deleted from the final on-site process. The remainder were included in the study and are shown in Table 1 of each volume. Selection of the sample for the private sector is discussed in depth in that particular volume.

In preparation for the on-site interviews, appropriate persons were contacted in the institution involved and were given a background description of the study, a suggested timetable for the interview process and were told what kind of information was being sought. This was all done in an effort to keep the time involvement of the individual contact persons at a minimum. During the actual on-site interview, generally lasting around one hour, the information was collected, questions asked and answered, and further informational contacts identified. Following this process, each on-site interview was written up in the form of a Training Program Summary, which where time allowed, was returned to the contact person for critiquing prior to inclusion in the report.

Throughout this process, individuals and institutions were given assurance that this study was not an attempt to evaluate program offerings and every attempt has been made on the part of the writers to live up to this assurance. Inclusion in this report provides no assurances of quality, nor should a program's exclusion be consideration of the lack thereof. In many instances certain programs within an institution were not included while others were, primarily due to the determination of the sample - previously discussed. This too should not be viewed in any qualitative manner.

REPORT ORGANIZATION:

The final report, of which this volume is a part, consists of volumes depicting a training profile in each medium under consideration, namely,

Air
Energy
Noise
Pesticides
Potable Water
Radiation
Solid Waste
Wastewater
Composite
Business and Industry and Trade Associations

At the outset it should be pointed out that there are very few degree programs conveying degrees in a particular medium; rather, degrees are offered in various specialties which lend themselves to obtaining employment in one or more of these fields. Nonetheless, to obtain maximum utility for the funding agency, programs were reported in this fashion. The Composite section was necessitated by the number of programs offering course work in multiple fields and differing specializations resulting from course selection. For convenience in handling of the data Potable Water, Wastewater and Composite have been reported in multiple volumes because of the numbers involved. Although separated into volumes either by degree level of the programs involved, as in the case of Potable Water and Wastewater, or by content as in the case of Composite, persons interested in any of these fields would be well advised to review each of the volumes to assure more complete coverage.

Along with the standard introductory pages common to volumes of this nature, each volume contains sections on Project Background, Introduction (consisting of sections devoted to a description of the programs surveyed and covered in the volume), Project Commentary, and the Training Summaries along with the Appendices.

REVIEW PROCESS:

In addition to individual training summary reviews conducted by the persons initially interviewed, each volume has been reviewed internally, by persons in the Environmental Protection Agency and by a select group of review committee members. In the final instance, individuals met during the on-site process were nominated by interviewers for inclusion on the review committee, primarily as a result of their obvious expertise in the field and their evidenced interest in the project.

These persons were then contacted by mail or by telephone in an effort to determine their willingness to serve. The rather stringent timelines necessary to keep the project on course and to deliver the finished product as specified were also detailed. In excess of one hundred persons returned their volumes (out of a mailing of 120) and all but five of these provided usable responses. In these five instances either last minute job demands prevented them from carrying out the review in the short timelines, or (in two instances) individuals indicated that they wanted nothing to do with the process. This particular method of review provided a wealth of valuable information, suggestions for revision of specific elements, and general comments helpful in revising the final documents. In all cases an effort was made to seriously consider and incorporate reviewer suggestions. The persons on the various review committees are individually acknowledged in the front of the volume they reviewed.

Photo reprinted from the University
of Missouri, Columbia Bulletin 1977.

INTRODUCTION

Photo reprinted from the
Northland College Catalog
1975-76

INTRODUCTION

Pesticides are a diverse group of chemicals which have been developed to kill, prevent, or suppress a wide variety of pests. Six of the most common types are insecticides (insects), herbicides (weeds), fungicides (fungi), molluscicides (snails and slugs), nematocides (nematodes), rodenticides (rodents), and acaricides (mites).

The usage of pesticides has been increasing dramatically in the United States in recent years. According to estimates of the U.S. Department of Agriculture, farm usage of pesticides (in millions of pounds, active ingredient) increased by approximately 40 percent between 1966 and 1971, while total U.S. use increased by 22 percent.[1] Between 1971 and 1975, pesticide use in the U.S. further increased by 46.5 percent, and in 1973 along 1.36 billion pounds of pesticides were manufactured in the United States.[2]

The availability of synthetic compounds, including pesticides, has contributed to significantly increased agricultural production yields, especially during the period from 1960 to 1971. In addition to controlling insects and disease, they have contributed to the public health by augmenting the production of food and fiber. This increase in crop yield per acre may be seen in EXHIBIT 2. Also noteworthy is the relationship to United States population growth (EXHIBIT 1).

EXHIBIT 1

U.S. POPULATION 1960 - 1977

	1960	1971	1974	1977
Millions of People	180	206	211.2	216.3
%age of Growth Over Previous Figure		14.4%	3.2%	2.4%
TOTAL GROWTH 1960-1977	20% population increase			

EXHIBIT 2

GROWTH IN

U.S. YIELDS PER HARVESTED ACRE (SELECTED CROPS)[3]

(in bushels per acre unless specified otherwise)

CROPS	1960-1971	1971-1974	1960-1974
All wheat	30% increase	19% decrease	5% increase
Rye	43% increase	23% decrease	10% increase
Oats	29% increase	17% decrease	7% increase
Grain corn	61% increase	19% decrease	17% increase
Rice (lbs./acre)	38% increase	6% decrease	30% increase
Cotton lint	2% increase	1% increase	1% increase
All hay (tons/acre)	20% increase	stable	19% increase

The demands on crop production capabilities become dramatic when considered alongside U.S. Department of Commerce, Bureau of the Census population estimates for this country. Still contributing to the cause for alarm is the fact that in this country an average of one million acres of potential or actual cropland are rendered agriculturally useless each year through urban development, reservoirs, and other sometimes irreversable types of development.[4]

The effect of the use of fertilizers and, specific to this report, pesticides, must not be regarded casually. The management of environmental variables which would reduce or destroy our ability to feed the population is essential; however, the use of pesticides is not without major drawbacks. Some of the most notable of these include:

1) Many of the more than 45,000 registered synthetic commercial pesticides have selective population toxicity, and many are injurious or fatal to humans when injested or absorbed in sufficient quantitites. Effects such as confusion, delusions, depression, schizophrenia, sterility, cancer, congenital deformities, genetic mutations, and paralysis have been attributed by the medical community to pesticide poisonings. These effects have been noted most often in agricultural workers, but also in workers in chemical manufacturing plants. The general population may absorb pesticides from a variety of sources, including the air, water and food, and surfaces touched.

2) Many pesticides are highly persistent, and soluble in fat or oil. These qualities aid them in working their way up in the food chain, as well as aiding them in working their way into insects. Some of these chemicals are found worldwide in fish, chickens, birds, and many plant and animals in the Atlantic Ocean.[5]

3) Pesticides frequently have effects on the plant treated as well as on the target pest, and may lead to selection in favor of resistant varieties of pests. This and other factors often increase the need for further treatment.

4) Some pesticides and other chemicals may have very harmful effects on the general environment. A March 1974 study published by the Senate Agriculture and Forestry Committee stated that sediment from land erosion is by far the major pollutant of surface waters. Approximately two billion tons of sediment enter the surface waters annually in the U.S. This sediment is often charged with nutrients and pesticides.[6] Pesticides in waterways have also been caused by leakage or discharge from chemical plants.

The Federal Insecticide, Fungicide, and Rodenticide Act of 1972, as amended by PL 94-140 of 1975 forbids anyone to use a pesticide contrary to label instruction, gives the Environmental Protection Agency (EPA) authority to restrict a pesticide so that only people trained in approved programs may apply them, and extends control to products sold intrastate. The EPA may suspend a registration if it is determined that use of a particular pesticide is an imminent hazard to human health. States are carrying out enforcement responsiblities as well as providing training and certification services to applicators of restricted pesticides.

Further regulation of potentially hazardous synthetic chemicals (excluding those used only in pesticides, food, food additives, drugs, and cosmetics) is provided by the Toxic Substances Control Act of 1976 (TSCA). This federal law authorizes the EPA to obtain production and test data from industry on selected chemical substances and mixtures, and to regulate the substances when needed. The law is specifically designed to improve the understanding of more than 30,000 chemical substances in commerce (a thousand new ones may be introduced each year), and to provide controls on any chemical which may threaten human health or the environment.[7]

Corresponding to TSCA are the activities of the National Institute of Environmental Health Sciences (NIEHS). The Scientific Director's and laboratory and branch chiefs' annual meeting identified several areas where need for academic and research expansion exists. The outcome of this is the establishment of new programs in behavioral toxicology and epidemiology, with particular emphasis on mutagenesis (biochemical, mammalian and population genetics, in vitro mutagenisis testing), pharmacology (marine biomedicine and pharmacology, lung toxicology), toxicology (Environmental Teratology Information Center), and biometry (statistical support). Several areas were found to require shifts in emphases; these include the areas of toxicology (marsupial program, teratology), pharmacology (pharmacokinetics, toxication-detoxication), biophysics (dose-response extrapolations, microwaves), and mutagenesis (non-mammalian genetics).[8]

It is clear that the topics of pest management and toxicology demand exacting technical and scientific skills, expertise, and experience. As the pressure grows to maintain high crop yields, while keeping the level of pollutants and toxicants within the federal guidelines, the need for appropriate academic, research, and vocational education and training multiplies.

Phase I of the National Environmental/Energy Workforce Assessment provided an in-depth review of the federal and state pesticide programs, and provided data regarding the workforce levels in pesticide regulation. Phase I data indicated that during 1976 there were 1,650 persons at the state level working in pesticides programs; according to state sources, this number will increase by 15 percent, to approximately 1,933 by 1982. Phase I also indicated that there were 199 persons in EPA in pesticide regulation in 1976, and this number is expected to increase to 273 by 1982 (a 27 percent increase). The number of commercial pesticide applicators will probably increase by an average of five percent annually, while the number of private applicators will decrease as more skillful application proves most economical.

Skilled workforce requirements in the area of integrated pest management (IPM) are also projected to increase, according to Phase I data. This area has begun to receive research and program support from the EPA, the U.S. Department of Agriculture, and states. The goal of a system of IPM is to reduce pest populations below economic threshold levels utilizing a single or a combination of tactics that optimize productivity, net return, and environmental quality. Measures employed by systems of IPM include such methods as quarantine at entry ports, production of weed-free seeds, breeding plants for disease resistance, proper culturing, and biological controls (e.g., use of pests' natural predators, and sterilization of male pests). The use of chemical controls is acceptable but that use is an integrated part of a management plan so as to minimize disruptive effects. By definition, a pest management program should embrace the totality of crop protection.

TSCA was not signed into law until the end of the Phase I Assessment; however, limited information is available concerning workforce impacts at the federal level. An EPA staff for TSCA of 116 (with a ceiling of 196) was functional in 1977, and this staff is expected to increase to about 400 during Fiscal Year 1979. Most in demand will be toxicologists and pharmacologists, as well as professionals of other scientific disciplines. The main source of demand, however, has been industry, largely due to the increasing number of litigations.[9] The reporting demands of TSCA are also expected to increase the needs for these professionals by private industry.

This report expands upon Phase I data of the pesticides/toxicology workforce, providing information on educational/training programs in these fields. It presents descriptions of 26 degree programs in the United States, which postulate a variety of approaches to the task of pest management. They range from the certificate to the doctoral level. The report also describes three non-degree-granting research and/or training efforts in the field of pesticide safety. It should be noted that certification training for pesticide applicators was described, by state, in the Phase I reports.

The pesticides certificate/associate programs focus on pest control technology in the areas of agricultural pest control, urban pests management, and plant protection. Courses common to all or most of these programs include the subjects of general environmental health; pesticides (selection, characteristics, safety); spray equipment; insect, rodent, and weed control techniques (industrial, agricultural, garden and nursery, household); insect and weed identification, and pest control business administration. Other related courses that are represented include toxicology, epidemiology, ecology, mycology, plant pathology, entomology, health-related aspects of pests and pest control and disease control, field research procedures, fertilizers and soils, crop production, and livestock diseases in basic science disciplines such as chemistry, biology, botany, and zoology. Some programs also require courses in such subjects as English, mathematics, social and behavioral sciences, and economics.

Bachelor level programs are nearly evenly divided between the classifications of entomology and pest management. Programs described as emphasizing pest management in most cases include courses in weeds and weed control, economic entomology, pest management (agricultural and forest), and anatomy and physiology of insects in their curricula. One or more of these program also includes the related subjects of environmental pollution, insect biology and ecology, systematic and medical entomology, vector relationships, pesticide application, plant physiology and pathology, and soil management. Students enrolled in pest-management options typically include science courses in their curricula such as genetics, biology, botany, ecology, zoology and chemistry, as well as a course in agribusiness management. Bachelor students in the entomology programs surveyed often include in their studies basic, economic, medical, and agricultural entomology. Related courses offered in at least one of these programs include the principles of biological and chemical insect control; structural pest control, public health and environmental toxicology; insect behavior, classification, structure, ecology, and histology; chemistry and toxicology of pesticides; aquatic entomology; systematic entomology; and forest protection. These students also typically take courses in microbiology, genetics, botany and zoology.

Graduate curricula surveyed may also be classified as according to academic emphasis. Courses available to these students typically include those offered in the bachelor entomology and pest management programs, respectively, though usually at more advanced levels. Classical entomology students at this level also focus mainly upon insect pathology, physiology, behavior, and control. Also offered are advanced courses in toxicology of pesticides, biological control, entomological research, and various other specialized aspects of the entomology field. Those graduate curricula surveyed in pest management typically include the bases of entomology, as well as in plant protection. Graduate programs often include special problem courses in specific areas, seminars, and thesis/dissertation research.

One of the non-degree pesticides programs included in this report has presented training for various health professionals throughout the country in recognizing, managing, preventing, and verifying cases of pesticide poisoning. Another develops, produces, and distributes college level materials for off-campus teaching and open learning in the fields of pests, pesticides, and pesticide safety. A third program is a pesticide research center that provides consultation services and analytical support in pesticides work for universities, governmental agencies, and farmers.

In addition to the pesticide programs, this report presents data on seven toxicology educational programs (one bachelor and six graduate). The bachelor level program is in environmental toxicology, and offers course work in such subjects as environmental protection, environmental toxicants, biological effects of toxicants, and legal aspects of environmental toxicology. Within the majority of the graduate programs, the student may choose a concentration in some aspect of toxicology (e.g., environmental toxicology, neurobehavioral toxicology, inhalation pharmacology, or radiation toxicology). Curricula in environmental toxicology often include courses related to air pollution toxicology, radioisotope and tracer techniques, environmental hygiene and policy, and public health. Also, typically incorporated in these curricula are courses in pharmacology, physiology, biochemistry, anatomy, biostatistics, and laboratory instrumentation.

Each of the programs surveyed in toxicology and pesticides is described individually in the Pesticides Educational/Training Summaries section of this report. The reader is also referred to Table 11, on page which provides data summaries for the degree programs on such variables as enrollment, graduates, faculty, graduate employment, and work-study programs. Additional information is presented on these programs in narrative and tabular form, which are detailed in the Table of Contents.

The following is a glossary of terms specific to this volume:

detoxication - the process whereby a toxic agent is either removed or metabolically converted to a less toxic compound.

EMIC (Environmental Mutagen Information Center) - computerized data bank conducted at Oak Ridge National Laboratory in Tennessee.

entomology - a branch of zoology which deals with insects.

environment - the complex of all external conditions (climatic, adaptic, biotic) which interact with influence and ultimately determine the form and survival of an ecological community or an individual.

mutagenesis - the study of significant and permanent changes is hereditary material involving either a physical change in chromosome relations or a fundamental change in genes.

nematology - a branch of zoology which studies any of a class or phylum (Nematoda) of elongated cylindrical worms parasitic in animals or plants or free-living in soil or water.

pathology - the study of the essential nature of diseases and especially of the structure and functional changes produced by them.

pharmacokinetics - the study of the properties of and reactions of drugs especially with relation to their therapeutic value.

toxic agents - substances that kill or injure an organism through their chemical or physical action or through altering its environment.

toxicology - a science dealing with poisons, their actions, their detection, and the treatment of the conditions they produce.

For a complete listing of all schools and program included in the Phase II study in all program areas, see Table 1, which follows.

FOOTNOTES

[1] Council on Environmental Quality, The Sixth Annual Report of the Council on Environmental Quality (Washington, D.C.: U. S. Government Printing Office, 1975), p. 454.

[2] Robert C. Oelhaf, "The Economics of Organic Farming" (Ph.D. dissertation, University of Maryland, 1976), p. 76.

[3] Ibid., Council on Environmental Quality, p. 457.

[4] U.S. Department of Commerce, Bureau of the Census, Statistical Abstract, 1977.

[5] G. Tyler Miller, Jr., Replenish the Earth - A Primer in Human Ecology (California: Wadsworth Publishing Company, 1972), pp.91-92.

[6] U.S. Environmental Protection Agency, "Clean Water and Agriculture", Office of Public Affairs (A-107), January, 1977.

[7] U.S. Environmental Protection Agency, "Toxic Substances Control Act" Office of Toxic Substances, (October 7, 1976).

[8] U.S. Department of Health, Education and Welfare, Preventing Environmentally-Related Diseases (Washington, D.C.: U.S. Government Printing Office, 1977), p. 12.

[9] Paul B. Hammond and James L. Whittenberger, et al.,"Professional and Scientific Education and Personnel", Human Health and the Environment - Some Research Needs, Report of the Second Task for Research Planning in Environmental Health Science, U.S. Department of Health, Education and Welfare, Public Health Service/National Institutes of Health, National Institute of Environmental Health Science. December, 1976, p. 459.

TABLE I

PARTICIPATING INSTITUTIONS

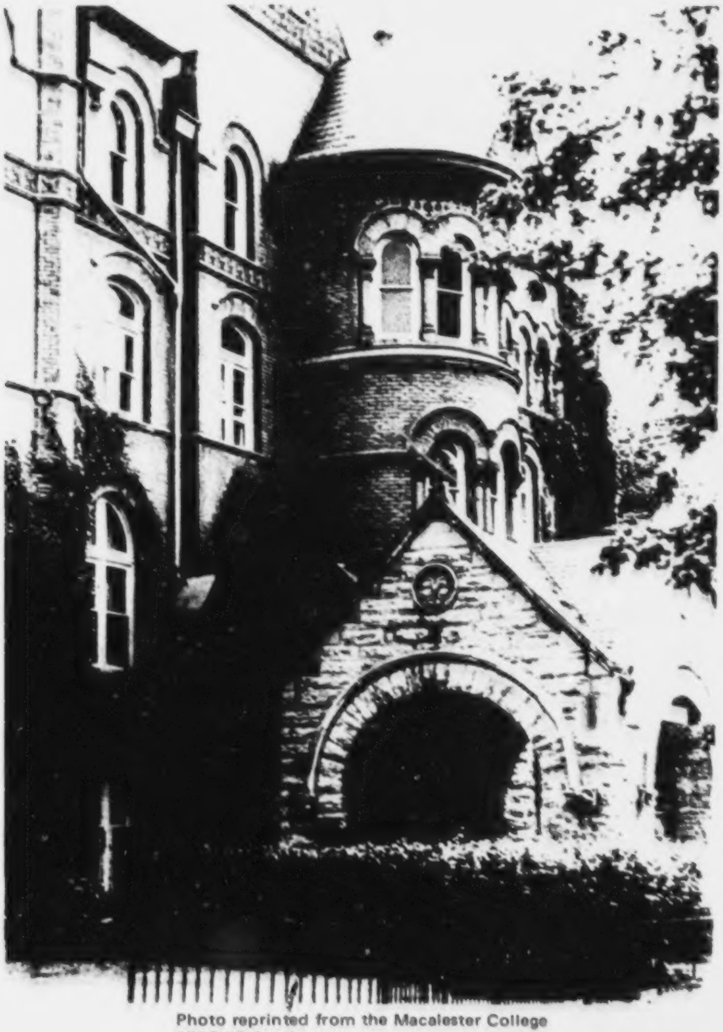

Photo reprinted from the Macalester College 1976-78 Catalog

Table 1 is a comprehensive listing of all institutions which participated in the post-secondary educational profile of the National Environmental/Energy Workforce Assessment. Listed by state, institution, and degree are programs surveyed in the areas of air, energy, noise, pesticides, potable water, radiation, solid waste and wastewater.

An explanation of the degree abbreviations utilized within the report may be found in Appendix I, entitled "Degree Abbreviations". For a complete listing of the institutions visited in a media specific area (i.e., air, energy, etc.), attention is drawn to Appendix IV, entitled "Participating Institutions by Environmental Category".

The Table in part III of the Project Findings, entitled "A Summary Profile of Representative Educational Programs" follows the narrative and is a presentation of specific institutions visited for the particular volume.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)*
AL	University of Alabama University	Environmental Engineering	M.S. (3)
AK	University of Alaska Fairbanks	Environmental Quality Engineering Science	M.S.
AR	University of Arkansas Fayetteville	Agricultural Engineering	B.S. M.S. Ph.D.
		Civil Engineering	M.S.C.E.
		Environmental Engineering	M.S.En.E.
		Environmental Science	B.S.
CA	California Institute of Technology Pasadena	Environmental Engineering Science	M.S. Ph.D.
	California Polytechnic State University San Luis Obispo	Environmental Engineering	B.S.
	California State University-Sacramento Sacramento	Civil and Environmental Engineering	B.S. M.S.
	Stanford University Stanford	Environmental and Water Studies	M.S. Ph.D.
	University of California-Berkeley Berkeley	Nuclear Engineering	B.S. M.S. M.E. Ph.D. D.E.
		Pest Management	B.S.
		Sanitary Engineering	M.S. M.E. Ph.D.
	University of California-Davis Davis	Environmental Toxicology	B.S.
		Plant Protection and Pest Management	M.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of California-Davis (Cont'd)	Entomology	B.S. M.S. Ph.D.
	University of California-Riverside Riverside	Pest Management	M.S.
	University of California-Santa Barbara Santa Barbara	Environmental Studies	B.A.
CO	Colorado State University Fort Collins	Environmental Engineering (Civil)	M.S. Ph.D.
	Community College of Denver-Red Rocks Golden	Water-Wastewater Technology	A.A.
CT	Hartford State Technical College Hartford	Nuclear Engineering Technology	A.S.
	Yale University New Haven	Environmental Health	M.P.H.
DE	Delaware Technical and Community College Newark	Environmental Engineering Technology	A.A.S.
	University of Delaware Newark	Entomology and Applied Ecology	B.S.
		Environmental Engineering	M.A.S. M.E. Ph.D.(App. Science) Ph.D.(ChE)
DC	Catholic University Washington	Civil Engineering	B.S.
	Howard University	Environmental Engineering	M.E.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
FL	Broward Community College Fort Lauderdale	Pest Control Technology	A.S.
	Central Florida Community College Ocala	Radiological Health Technology	A.S.
	Florida International University Miami	Environmental Studies	B.A. B.S.
		Environmental Engineering Technology	B.S.
	Heed University Hollywood	Ocean and Environmental Affairs	M.A. Ph.D.
	Miami-Dade Community College Miami	Environmental Engineering Technology	A.S.
		Marine Science Technology	A.S.
	University of Florida Gainesville	Air Pollution	M.E. M.S. Engineer Ph.D.
		Environmental Biology	M.E. M.S. Engineer Ph.D.
		Environmental Resources Management Activities	M.E. M.S. Engineer Ph.D.
		Systems Ecology	M.E. M.S. Engineer Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Florida (Cont'd)	Water Supply and Water Pollution Control	M.E. M.S. Engineer Ph.D.
		Nuclear Engineering	B.S.(N.E.) B.S.E.(N.E.) M.E. M.S. Engineer Ph.D.
		Radiological Sciences	M.E. M.S.
	University of Miami Miami	Marine and Atmospheric Science	M.S. Ph.D.
GA	Abraham Baldwin Agricultural College Tifton	Plant Protection	A.Ag.
	Atlanta University Center/ Georgia Institute of Technology Atlanta	Water Pollution Control Design Engineering	B.S. B.E.
	Georgia Institute of Technology Atlanta	Acoustical Engineering	Advanced Cert.
		Energy Engineering	Advanced Cert.
		Environmental Studies	Advanced Cert.
	Southern Technical Institute Marietta	Nuclear Safety	A.S.
	University of Georgia Athens	Entomology	B.S. A.B. M.S. M.P.P.P.M. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Georgia (Cont'd)	Environmental Health Science	B.S.E.H.
HI	University of Hawaii Honolulu	Environmental and Sanitary Engineering	M.S.
IL	Illinois Institute of Technology Chicago	Environmental Engineering	B.S.E.S. M.S. Ph.D.
	Prairie State Community College Chicago Heights	Air, Water, Wastewater	A.A.S.
	Sangamon State University Springfield	Environments and People	B.A. M.A.
	Southern Illinois University-Edwardsville Edwardsville	Wastewater Treatment Operator Training	Cert.
IN	Indiana University Bloomington	Environmental Programs	Cert. A.S. B.A. B.S. M.P.A. M.S.E.S. Ph.D. (minor)
	Purdue University West Lafayette	Environmental Sciences Option	B.S.
		Nuclear Engineering	B.S.N.E. M.S. Ph.D.
IA	Iowa State University Ames	Environmental Studies	B.A. B.S.
		Sanitary Engineering and Water Resources	M.S. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Kirkwood Community College Cedar Rapids	Environmental Health Assistant	Diploma
		Environmental Health Technician	A.A.
		Water and Wastewater	Diploma
	University of Iowa Iowa City	Environmental Engineering	M.S. Ph.D.
		Environmental Toxicology	M.S. Ph.D.
KS	Kansas State University Manhattan	Chemical Engineering	B.S. M.S. Ph.D.
		Mechanical Engineering	B.S. M.S. Ph.D.
		Nuclear Engineering	B.S. M.S. Ph.D.
		Sanitary Engineering	M.S.C.E.
	University of Kansas Lawrence	Environmental Health Engineering	M.S. Ph.D.
		Environmental Health Science	M.S. Ph.D.
		Environmental Studies	B.A.
		Radiation Biophysics	B.A. B.S. M.S. Ph.D.
		Water Resources Engineering and Science	M.S. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
KY	Morehead State University Morehead	Environmental Studies	B.S. A.B.
		Mining Technology	A.A.S.
	Pikeville College Pikeville	Mining Technology	A.M.T.
	University of Kentucky Lexington	Energy (Coal) Engineering	M.S. Ph.D.
		Environmental Engineering	M.S. Ph.D.
	University of Louisville Louisville	Environmental Engineering	B.S. M.Eng.
	Western Kentucky University Bowling Green	Environmental Science	B.S.
		Environmental Engineering	B.S.
LA	Delgado College New Orleans	Urban Pest Management	A.S.
		Water/Wastewater Technology	A.S.
		Environmental Health Technology	A.S.
	McNeese State University Lake Charles	Environmental Science	B.S. M.S.
ME	Eastern Maine Vocational Technical Institute Bangor	Environmental Control Technology	A.A.S.
	New England Regional Wastewater Institute (S. Maine Vocational Technical Institute) S. Portland	Wastewater Treatment Technology	Cert.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Maine-Orono Orono	Sanitary Engineering	M.S.C.E. Ph.D.
MD	Charles County Community College La Plata	Pollution Abatement Technology	A.A.
	Johns Hopkins University Baltimore	Environmental Engineering	M.A. M.S.E. M.S. Ph.D
	University of Maryland College Park	Environmental Engineering	M.S.
		Nuclear Engineering	M.S.
		Pest Management	M.S.
MA	Harvard University Cambridge	Environmental Health Sciences	S.M. Sc.D.
		Environmental Sciences and Engineering	S.M. M.E. Ph.D.
		Toxicology	S.M. Sc.D.
	Massachusetts Institute of Technology Cambridge	Acoustics	S.M. Sc.D./ Ph.D.
		Environmental Engineering	Env.E.
		Mineral Resources Engineering and Management	S.M. Engr. Sc.D./ Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Massachusetts Institute of Technology (Cont'd)	Nuclear Engineering	S.B. S.M. N.E. Sc.D./ Ph.D.
		Water Resources and Environmental Engineering	S.B. S.M. Sc.D./ Ph.D.
		Wastewater Treatment Plant Operations	Cert.
	Northeastern University Boston	Environmental Engineering and Science	M.S.
	Springfield Technical Community College Springfield	Environmental Technician	A.S.
	Tufts University Medford	Environmental Health Engineering	B.S.C.E. M.S.
	University of Lowell Lowell	Radiological Health Physics/Radiological Sciences and Protection	B.S. M.S.
		Wastewater Treatment Plant Operations	Cert.
MI	Ferris State College Big Rapids	Environmental Health Technician	A.A.S.
		Environmental Health	B.S.
	Michigan State University East Lansing	Environmental Conservation Education	M.S. Ph.D.
		Environmental Engineering	B.S.C.E. M.S. (emphasis) Ph.D. (emphasis)

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Michigan State University (Cont'd)	Natural Resources and Environmental Education	B.S.
		Systems Science (Ecological Systems)	B.S. M.S. Ph.D.
	Michigan Technological University Houghton	Environmental Engineering	B.S.C.E. B.S.E. M.S.C.E.
	University of Michigan Ann Arbor	Environmental Education	M.S.
		Environmental Sciences Engineering	B.S.
		Industrial Hygiene and Air Pollution	M.P.H. M.S. Dr.P.H. Ph.D.
		Radiological Health	M.P.H. M.S. Dr.P.H. Ph.D.
		Water Resources: Engineering	M.S.E. Ph.D.
		Management Science	M.S. Ph.D.
		Water Quality	M.P.H. M.S. Dr.P.H. Ph.D.
MN	Bemedji State College Bemedji	Environmental Studies	B.S. M.A.
	Macalester College St. Paul	Environmental Studies	B.A. B.S.
	University of Minnesota Minneapolis	Environmental Health	M.P.H. M.S. Ph.D.

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STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
MS	Mississippi State University Mississippi State	Specialized Training in Pest Management	M.Ag.
MO	Missouri Southern State College Joplin	Environmental Health Technology	A.S. B.S.
		Radiologic Technology	A.S.
	St. Louis Community College at Forest Park St. Louis	Radiologic Technology	A.S.
	University of Missouri-Columbia Columbia	Sanitary Engineering	B.S. M.S. Ph.D.
	University of Missouri-Rolla Rolla	Environmental and Sanitary Engineering	M.S. Ph.D.
	Water and Wastewater Technical School Neosho	Water and Wastewater Training	Cert.
	Washington University St. Louis	Air (emphasis)	M.S. D.Sc.
MT	Montana State University Bozeman	Environmental Engineering	M.S.
		Environmental Health Technology	M.S.
	Northern Montana College Havre	Environmental Health Technology	A.A. Cert.
NE	Central Technical Community College Hastings	Agriculture Technology	Cert. 1-Year Diploma 2-Year Diploma A.A.S. A.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Nebraska Lincoln	Sanitary Engineering	B.S. M.S. Ph.D.
		Water Resources Engineering	M.S.
		Planning and Management	M.S.
NH	University of New Hampshire Durham	Entomology	B.S. B.A.
NJ	Middlesex County College Edison	Environmental Health Science Technology	A.A.S.
	New Jersey Institute of Technology Newark	Interdisciplinary Studies in Environmental Engineering	M.S.
	Princeton University Princeton	Energy Conversion and Resources	Topical Programs
	Rutgers-SUNJ New Brunswick	Biology (option in entomology)	B.S. B.A.
		Entomology and Economic Zoology	M.S. M.P. Ph.D.
		Environmental and Business Economics	B.S.
		Environmental Science	M.S. Ph.D.
		Environmental Studies	B.S.
		Environmental and Water Resources Engineering	M.S. Ph.D.
		International Environmental Studies	B.A. B.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Rutgers-SUNJ (Cont'd)	Radiation Sciences	M.S. Ph.D.
	Stevens Institute of Technology Hoboken	Air Pollution Control Engineering	Cert.
		Water and Wastewater Engineering	Cert.
NM	New Mexico State University Las Cruces	Pest Management	B.S.
	University of New Mexico Albuquerque	Nuclear Engineering	M.S. Ph.D.
NY	Clarkson College Potsdam	Civil and Environmental Engineering	B.S. M.S.
	Columbia University New York City	Nuclear Engineering	B.S. M.S. Nuc.Engr. Eng.Sc.D.
	Cornell University Ithaca	College Program in Energy Conversion	B.S.
		Environmental Engineering	B.S. M.S. M.Eng. Ph.D.
		Waste Management Engineering	M.S. M.Eng. M.P.S. Ph.D.
		Nuclear Engineering	M.Eng. M.S. Ph.D.
	Hofstra University Hempstead	Solid Waste Management	Cert.
	Hudson Valley Community College Troy	Public Health Technology (Environmental option)	A.A.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Hunter College New York City	Environmental Health Science	B.S. M.S.
	Manhattan College New York City	Environmental Engineering and Science	M.S. M.E.
	Polytechnic Institute of New York New York City	Energy Engineering and Policy	Cert. M.S.
		Environmental Engineering and Planning	M.S.C.E. M.E.H.S. Engr. Ph.D.
	Rensselaer Polytechnic Institute Troy	Environmental Engineering	B.S. M.E. M.S. D.E. Ph.D.
		Nuclear Engineering	B.S. M.S. M.E. Ph.D.
	Rochester Institute of Technology Rochester	Civil Engineering Technology (Environmental option)	B.T.
	State University of New York-Buffalo Buffalo	Water Resources and Environmental Engineering	B.S. M.S. Ph.D.
	State University of New York Farmingdale	Pest Control Technology	A.A.S.
	Syracuse University Syracuse	Chemical Engineering	B.S. M.S. Ph.D.
		Environmental Engineering	B.S.
		Sanitary Engineering, Sanitary Science, Civil Engineering	M.S.(S.E.) M.S.(S.S.) Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	The Cooper Union New York City	Integrated Master's Program with concentration in Environmental Engineering	M.E.
	Ulster County Community College Stone Ridge	Water Quality Management Training	A.A.S.
	University of Rochester Rochester	Toxicology Training Program	M.S. Ph.D.
NC	Duke University Durham	Environmental Management	M.E.M.
		Civil Engineering/ Urban and Environmental Engineering	M.S. Ph.D.
	North Carolina State University Raleigh	Agricultural Pest Control	A.A.S.
		Pest Management	B.S. M.S. (minor)
		Air Conservation	M.S. (minor) M.E. (minor) Ph.D.(minor)
		Environmental Engineering	M.S. M.C.E. Ph.D.
		Acoustic, Noise Vibration	M.S. M.M.E. Ph.D.
	University of North Carolina Chapel Hill	Air and Industrial Hygiene	M.S. M.S.P.H.
		Environmental Chemistry and Biology	M.S. M.S.P.H. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of North Carolina (Cont'd)	Environmental Management Protection	M.S. M.S.P.H. Ph.D.
		Radiological Hygiene	M.S. M.S.P.H. Ph.D.
		Water Resources Engineering	M.S. M.S.P.H. M.S.E.E. Ph.D.
	Wilson County Technical Institute Wilson	Sanitary Landfill Operating Manager	Cert. Diploma A.A.S.
		Sanitary Landfill Technology	A.A.S.
ND	North Dakota State School of Science Wahpeton	Environmental Science Technology	A.A.
OH	Antioch College Yellow Springs	Environmental Studies	B.S.
	Hocking Technical College Nelsonville	Environmental Health Technology	A.A.S.
	Miami University Oxford	Environmental Science	M.En.
	Muskingum Area Technical College Zanesville	Environmental Quality Control Technology	A.A.S.
		Natural Resources Conservation Technology	A.A.S.
		Petroleum Engineering Technology	1-Year Cert. A.A.S.
	Ohio State University Columbus	Agricultural Engineering	B.S. M.S. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Ohio State University (Cont'd)	Chemical Engineering (air)	B.S. M.S. Ph.D.
		Civil Engineering	B.S. M.S. Ph.D.
		Environmental Biology	M.S. Ph.D.
		Environmental Education	B.S.(Ed.) B.S.(N.R.) M.S. Ph.D.
		Toxicology (Pharmacology)	M.S. Ph.D.
	Ohio University Athens	Environmental Studies	M.S.
	Raymond Walters General and Technical College (University of Cincinnati) Cincinnati	Environmental Control/ Protection Technology	A.S.
	University of Cincinnati Cincinnati	Air Pollution and Industrial Hygiene	M.S. Ph.D.
		Civil and Environmental Engineering	M.S. Ph.D.
		Environmental Health	M.S. Ph.D.
		Mechanical and Industrial Engineering (noise)	B.S. M.S. Ph.D.
		Occupational Medicine	M.S. Ph.D.
		Toxicology	M.S. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Cincinnati (Cont'd)	Acoustics and Noise Control	B.S. M.S. Ph.D.
	University of Toledo Toledo	Chemical Engineering, Civil Engineering	B.S. M.S.
		Engineering Science	M.S.
OK	East Central Oklahoma State University Ada	Environmental Science	B.S.
	OSU Oklahoma City Technical Institute Oklahoma City	Civil Technology	A.S.
	Oklahoma State University Stillwater	Engineering Technology	A.D. B.S.
		Radiation and Nuclear Engineering Technology	A.D. B.S.
	Oscar Rose Junior College Midwest City	Wastewater Technology	A.A.S.
		Environmental Science	A.A.S.
	University of Oklahoma Norman	Environmental Science	B.S. M.S. Ph.D.
OR	Linn-Benton Community College Albany	Wastewater Technology	A.S.
		Water/Wastewater Technology	A.S.
		Water/Wastewater Plant Operator	Cert.
	Oregon Institute of Technology Klamath Falls	Environmental Technology	A.A.S. B.T.
	Oregon State University Corvallis	Nuclear Engineering Technology	B.S.
		Nuclear Engineering	B.S. M.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Oregon State University (Cont'd)	Pest Management and Plant Pathology	B.S. M.S.
	Portland State University Portland	Engineering and Applied Science	B.S. M.S.
PA	Carnegie-Mellon University Carnegie Institute of Technology Pittsburgh	Environmental Engineering	B.S. M.S. Ph.D.
	Drexel University Philadelphia	Environmental Engineering and Science	M.S.E.E. M.S.E.S. Ph.D.
	Pennsylvania State University University Park	Acoustics	M.E. M.S. Ph.D.
		Air Pollution Control Technology	A.A.P.C.T.
		Entomology	B.S. M.Agr. M.S. Ph.D.
		Environmental Engineering	B.S. M.S. M.E.E.E. Ph.D.
		Environmental Pollution Control	M.S. M.E.P.C. M.E.
		Environmental Resource Management	B.S.
		Minerals Processing	M.S. Ph.D.
		Mining Technology	A.A.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Pennsylvania State University (Cont'd)	Mining Engineering	B.S. M.S. M.E. Ph.D.
		Nuclear Engineering Technology	A.N.E.T.
		Nuclear Engineering	B.S. M.S. M.E. Ph.D.
		Petroleum and Natural Gas Engineering	B.S. M.S. Ph.D.
		Water Resources Engineering Technology	B.T.
	Slippery Rock State College Slippery Rock	Environmental Studies	B.S.
	Temple University Philadelphia	Environmental Technology	A.T.
		Environmental Engineering Technology	B.S.
	University of Pennsylvania Philadelphia	Energy Engineering	M.S.E.
		Energy Management and Policy	M.S.E.M.P. Ph.D.
	University of Pittsburgh Pittsburgh	Environmental and Sanitary Engineering	B.S. M.S. Ph.D.
		Environmental Systems Engineering	degrees granted through Engr. Dept.
	School of Public Health (University of Pittsburgh) Pittsburgh	Acoustic Environmental Control	M.S.(Hyg.) D.S.(Hyg.)
		Air Resources	M.S.(Hyg.)

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	School of Public Health (University of Pittsburgh) (Cont'd)	Environmental Health Engineering	M.P.H. D.S.(Hyg.)
		Environmental Health Planning	D.S.(Hyg.)
		Health Aspects of Water Quality	M.S.(Hyg.)
		Industrial Hygiene	M.S.(Hyg.)
		Toxicology	D.S.(Hyg.) Ph.D.
		Radiation Health	M.S.(Hyg.) D.S.(Hyg.) Ph.D. D.P.H.
RI	University of Rhode Island Kingston	Environmental Engineering	B.S. M.S. Ph.D.
SC	Clemson University Clemson	Air Pollution	M.S. M.Engr.
		Natural Systems	M.S. M.Engr.
		Planning and Management	M.S. M.Engr.
		Water Treatment Systems	M.S. M.Engr.
		Environmental Systems Engineering	Ph.D.
	Greenville Technical College Greenville	Wastewater Technology	A.A.S.
	Sumter Area Technical College Sumter	Environmental Engineering Technology	A.E.T.
TN	Chattanooga State Technical Community College Chattanooga	Environmental Science Technology	A.S.
		Nuclear Technology	A.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	East Tennessee State University Johnson City	Environmental Health	B.S.E.H. M.S.E.H.
	Memphis State University Memphis	Audiology	M.A. Ph.D.
	Middle Tennessee State University Murfreesboro	Environmental Science and Technology	B.S.
	State Technical Institute at Memphis Memphis	Environmental Engineering Technology	A.E.
	University of Tennessee Knoxville	Environmental Engineering	M.S.E.E. M.E. Ph.D.
		Environmental Engineering (Air Quality and Pollution Control)	M.S.E.E. M.E. Ph.D.
		Environmental Engineering (Water Pollution Control/ Water Resources)	M.S.E.E. M.E. Ph.D.
		Industrial Audiology	M.A.
		Nuclear Engineering	B.S. M.E. M.S. Ph.D.
		Water Resources Development	M.S.
	Vanderbilt University Nashville	Environmental and Water Resources Engineering (EWRE)	B.E.
		Environmental Science	B.S.
		EWRE (Environmental Science)	M.S. M.Eng. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Vanderbilt University (Cont'd)	EWRE (Air Resources)	M.S. M.Eng. Ph.D.
		EWRE (Solid Waste)	M.S. M.Eng. Ph.D.
		EWRE (Water and Wastewater Treatment/Water Resources)	M.S. M.Eng. Ph.D.
TX	Baylor University Waco	Institute of Environmental Studies	B.A. B.S.
	Lamar University Beaumont	Environmental Science	B.S.
		Energy Resource Management	B.S.
	Rice University Houston	Environmental Science and Engineering	M.S.
	Sam Houston State University Huntsville	Environmental Science	B.S.
	Texas A & M University College Station	Environmental Engineering	M.S. Ph.D.
		Entomology	M.S.
		Entomology/Pest Management Option	M. Ag.
	Texas State Technical Institution Waco	Nuclear Technology	A.A.S.
		Water/Wastewater Technology	A.A.S.
		Water Utility Operator	Certificate
	University of Texas Austin	Environmental Health Engineering	M.S. Ph.D.
		Water Resources Engineering	M.S. Ph.D.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
UT	Brigham Young University Provo	Chemical Engineering	B.S. M.S.
		Water Resources and Environmental Engineering	B.S. M.S.
	University of Utah Salt Lake City	Civil Engineering	B.S. M.E. M.S. Ph.D.
	Utah State University Logan	Civil and Environmental Engineering	B.S. M.S. Ph.D.
		Pest Management	B.S. M.S.
		Environmental Studies	B.S.
VA	George Washington University NASA-Langley Institute Hampton	Acoustics	M.S. Sc.D.
		Environmental Modeling	M.S.
	J.Sargeant Reynolds Community College Richmond	Environmental Technology Environmental Operations	Cert. A.A.S.
		Ground Water Resources	Cert.
	Virginia Polytechnic Institute and State University Blacksburg	Civil Engineering Technology	B.S.
		Sanitary Engineering/Environmental Sciences and Engineering/Civil Engineering	M.S. Ph.D.
	Wytheville Community College Wytheville	Environmental Technology	Cert.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
WA	The Evergreen State College Olympia	Coordinated Studies	B.A.
	University of Washington Seattle	Environmental Studies	B.A. B.S.
		Air Resources	M.S. Ph.D.
	Washington State University Pullman	Environmental Science	B.S. M.S.
		Chemical Engineering	M.S.
		Air Pollution Control Engineering	M.S.
		Air Pollution Science	M.S.
		Air Pollution Option	M.S.
		Air Pollution Program	M.S.
	Western Washington University Bellingham	Environmental Studies	B.S.
WV	Bluefield State College Bluefield	Mining Engineering Technology	A.S. B.S.
	West Virginia Institute of Technology Montgomery	Mining Engineering Technology	A.S.E.M.T. B.E.M.T.
	West Virginia University Morgantown	Engineering of Mines	B.S.
		Environmental Engineering	M.S.C.E. M.S.E.
		Mineral Processing Engineering	B.S. M.S.
		Mineral Resource Economics	M.S.
		Petroleum Engineering	B.S. M.S.

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PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
WI	Marquette University Milwaukee	Environmental Engineering	B.A. B.S.
	Northland College Ashland	Environmental Studies	B.A.
	University of Wisconsin-Green Bay Green Bay	Environmental Emphasis	B.A. B.S. M.E.A.S.
	University of Wisconsin-Madison Madison	Civil and Environmental Engineering	B.S.
		Environmental Communications	M.A. M.S.
		Water Resources Management, Environmental Monitoring, Land Resources	M.S. Ph.D.
	University of Wisconsin-Milwaukee	Atmospheric and Marine Environmental Program	M.S. M.E.
WY	Casper College Casper	Water Quality Technology	A.S.
	University of Wyoming Laramie	Civil Engineering	M.S. Ph.D.

Other Programs

The following programs were included in the on-site visit process and offer training through various institutes, centers, state agencies, or college consortiums. Program descriptions can be found in the volume specified.

State	Institution	Program	Volume
FL	Florida Department of Environmental Regulation	Environmental Noise Control Training	Noise
	Miami-Dade Community College	NPDES Effluent Monitoring Training	Wastewater I
		Wastewater Treatment Plant Operations	Wastewater I
		Water Treatment Plant Operations	Potable Water I
	University of Miami School of Medicine	Pesticide Protection	Pesticides
KS	Kansas State University	Institute for Environmental Research	Composite II III Business and Industry
MI	Michigan State University	Institute of Water Research	Potable Water I
		Pesticide Research Center	Pesticides
NE	University of Mid-America	Pests, Pesticides and Pesticide Safety	Pesticides

State	Institution	Program	Volume
NJ	Princeton University	Environmental Science and Policy	Composite I
NC	U.S. Environmental Protection Agency	Air Pollution Training Institute	Air
OH	Ohio State University	Center for Lake Erie Area Research	Potable Water I
		Cooperative Extension Service Activities	Composite II and III
		Water Resources Center	Potable Water I
PA	Air Pollution Control Association	Refresher, Continuing Education Courses	Air
	University of Pittsburgh	Environmental Systems Engineering	Composite I
TN	Memphis State University	Nuclear Reactor Fundamentals	Energy
		Radiation Technician Training Course	Radiation
	Oak Ridge Associated Universities	Radiation Emergency Assistance Center/ Training Site	Radiation
		Special Training	Energy Radiation
	University of Tennessee Center For Health Sciences	Training Courses in Audiometric Orientation	Noise

Photo reprinted from the Marquette University Bulletin 1977-78

PROJECT FINDINGS

Photos reprinted from the Michigan Technological University Catalog 1975-76

I. A SUMMARY PROFILE OF REPRESENTATIVE PESTICIDE/TOXICOLOGY EDUCATIONAL PROGRAMS.

A. States, Institutions, Programs and Degrees

Programs described in this volume were reviewed in twenty-one states and in twenty-six academic institutions. Three programs included in the study were considered non-institutional and were not degree granting. Considerable variance in size, description, and extent of topic coverage was observed. The thirty-four programs surveyed range in academic level from that of the certificate and diploma to that of advanced degrees, and are offered by institutions such as community colleges, private colleges, and state universities. The following table serves to illustrate the breadth of geographic coverage represented in this profile. The reader is asked to note the fact of a number of options being offered at more than one academic level, which allows a student to pursue those topics to whatever extent she/he chooses.

TABLE 2

STATES, PROGRAMS, DEGREES

Degree	Number of Programs	States
Associate	4	GA, FL, NC, NY
Certificate/Associate	2	LA, NE
Bachelors	8	CA, DE, GA, NC, NH, NM, TX
Bachelors/Masters	1	OR
Bachelors/Masters/Doctoral	4	CA, NJ, PA, UT
Masters	5	CA, MD, MS, TX
Masters/Doctoral	2	OH, IA
TOTAL	31	20

The remaining three non-institutional programs are offered in Maine, Florida, and Nebraska, and none offers any form of academic credit.

B. Enrollment Statistics and Graduates

Thirty-six options for degrees in pesticides and seven in toxicology have been addressed in the tables which appear in this section. These 43 degrees are offered through 33 active programs. It is important to note that these figures do not include all of the institutions in any one region. This is not to say that no pesticide- or toxicology-related programs exist in a particular region; rather, none have been reviewed.

Six associate level programs provided Phase II with enrollment and graduate figures. Five of these (83 percent) report their enrollment levels to be stable, with an average size of 25, and a range from 10 to 60 students.

Fifty-eight percent of the bachelor's programs under consideration for this report show a trend of increased enrollment and graduation figures. Bachelor's programs graduate approximately 20 percent of their enrolled students each year.

An average of 23 students are enrolled in master's programs. Growth has been experienced in half of the programs, and stabilization in 33 percent. For the past three years, master's programs have graduated nearly 26 percent of their students. Descriptive data for one master's program surveyed were not available to Phase II researchers.

Six doctoral programs appear in the pesticides report, with scant data on one of these. Four, or 67 percent, indicate that stable enrollment levels exist; and one shows program growth. An average of 13 percent of doctoral students graduates each year.

The following table serves to illustrate enrollment and graduate figures for Regions I through X; and again the reader is reminded that this is a representative sample, not a complete inventory.

TABLE 3

PESTICIDE ENROLLMENT PROFILE SUMMARY

(REGIONS I through X)

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Enrollment Change by Program Up	Down	Stable
Associate	147	1	46	1	0	6
Bachelors	374	11	107	7	0	5
Masters	236	4	51	5	0	6
Doctoral	69	0	11	2	0	3
TOTAL	826	16	215	15	0	20

The preponderance of enrollment and program growth falls in the bachelor's degree category. The highest ratio of student enrollment to the number of students graduating exists in associate programs, with 31 percent of the students completing associate degrees each year. The responsiveness of pesticide training programs to the rapidly growing need for qualified personnel may be observed in the "Graduate Enrollment Change by Program" column, which shows 51 percent are stable at their present size, and 43 percent are experiencing trends of growth.

Seven options in toxicology were reviewed; one in California, one in Iowa, one in Massachusetts, one in New York, and three in Ohio.

One Pennsylvania program has been included in the review because it offers related courses, but enrollment data are misleading because they refer to an entire department; so they have been omitted from Table 4. National figures are shown in Table 4 which follows:

TABLE 4

TOXICOLOGY ENROLLMENT PROFILE SUMMARY

(REGIONS I through X)

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Enrollment Change by Program Up	Down	Stable
Associate	0	0	0	0	0	0
Bachelors	42	0	22	0	0	1
Masters	4	1	3	2	0	0
Doctoral	52	0	10	3	0	2
TOTAL	98	1	35	5	0	3

Both bachelor's and master's programs graduate approximately half of their students each year. Fifty-seven percent of the toxicology programs have experienced growth over the past three years, a trend which may be expected to continue. Twenty percent of doctoral students receive degrees in these programs, a figure slightly higher than the matriculation rate for doctoral students in pesticide programs.

C. Student Origin--In-State, Out-of-State, Foreign

TABLE 5

NATIONAL SUMMARY OF STUDENT ORIGIN (PESTICIDES)

(Percentages)

Degree	In-State	Out-of-State	Foreign
Associate	96%	4%	
Bachelors	81%	18%	1%
Masters	47%	47%	6%
Doctorate	34%	60%	6%

It is significant to note the increased ratio of out-of-state students to in-state students in advanced degree programs. Phase II researchers observed that faculty found it desirable to attract students with varied backgrounds and thus enrich the departmental scope of subject coverage. Conversely, students find it advantageous to broaden their range of experience by attending insititutions in states other than where they took their bachelor's degrees. Influential also, is the factor of in-state tuition being substantially lower than that of out-of-state. Because of the limited number of options for undergraduate financial support, 81 percent of these students pursue degrees in their home states. Additional forms of student support at the advanced degree level allow students greater flexibility in selecting institutions, the result being a 29 percent increase in master's students leaving their home state (over bachelor's students). There is also a 27 percent rise in out-of-state doctoral enrollment. Toxicology program trends show a 64 percent in-state enrollment at the master's level, and 57 percent in-state enrollment at the doctoral level.

The University of Delaware finds that over one-third, or 36 percent, of its undergraduate enrollment are women, a figure roughly consistent with those at Rutgers State University of New Jersey, the University of Rochester, North Carolina State University, and the University of Georgia. At the Pennsylvania State University, 27 percent of the undergraduate enrollment are women, versus 11 percent in the graduate program. Seventeen percent of the University of New Hampshire students are women in contrast to the 50 percent which constitute the Harvard population. Both Broward Community College and the State University of New York have female enrollments of approximately 20 percent. One respondent related that his program had no women in the curriculum because the "girls don't want to" be enrolled. One toxicology source reported that a number of students pursue degrees in this program because they received rejections from medical schools, and toxicology programs represented a "close second."

D. Employment

Table 6 provides graduate employment percentages for individual programs in four broadly defined categories: industry, consulting, government, and other. Figures were provided by faculty members and were either "best estimates" or actual statistics collected. The column entitled "Graduate Follow-Up" in Table 11 serves as an indicator of reliability of the employment figures, i.e., whether actual follow-up studies are conducted or whether faculty provided estimates. Table 6 is a compilation of employment data from Table 11 which provides a national graduate employment picture. It is significant to compare the percentage of graduates of certificate/diploma and associate programs (75-80 percent) with those listed for graduates of bachelor's and master's programs (42-45 percent). The column which carries the heading "Combined" is intended to describe that data which was not separated according to industry or consulting occupations, and is therefore considered undifferentiated. There is a substantial increase in the percentage of bachelor's and advanced degree graduates who find employment with government. "Other" is chiefly reflective of those persons who are employed in the educational sector for conducting research and/or teaching. Nearly one-third of the doctoral graduates are employed in this sector.

TABLE 6

PESTICIDE/TOXICOLOGY EMPLOYMENT PROFILE-NATIONAL

(REGIONS I through X)

Degree	Private Sector		Combined	Government	Other
	Industry/	Consulting			
Certificate/ Diploma	80%	10%	-	10%	-
Associate	66%	3%	-	24%	7%
Bachelors	44%	.5%	4%	23%	28.5%
Masters	40%	9%	-	33%	18%
Doctoral	17%	2%	12%	31%	38%

The data in Table 6 were compiled for each degree level by utilizing the average annual graduate figures from each program, and basing calculations on the employment numbers for each in terms of real numbers. Whole numbers were added and percentages were derived from the national figures.

A discussion of specific occupations which graduates enter follows in Additional Findings.

E. Faculty

On page 83 of Table 11, it can be seen that pesticide and toxicology programs which are described in this volume are served by a total of 620 full and part-time faculty. Fifty-nine percent, or 369 of these, are part-time and the remaining 40 percent have full-time involvement. It should be mentioned that most of the so-called part-time faculty have full-time status in their respective departments, but their interaction with a particular academic program is clearly marginal.

The Staffing levels may be compared to the total full-time enrollment (documented in TABLES 3 and 4) at all degree levels of 926 students. Although a student faculty ratio could be developed from this information, it would be less than meaningful because:

1) some faculty members are engaged primarily in research;
2) a variety of departments supply faculty for occasional courses;
3) in addition to their regular course loads, some faculty members teach an overload (additional courses).

F. Internship/Applied Study Terms

A number of programs surveyed indicated they had some form of either required or optional applied study or internship program. Many provided students with the opportunity to receive financial assistance for their work.

All associate level students at Broward Community College participate in field service during the summer and during their final term prior to graduation. These students are placed in full- or part-time positions with the pest control industry, in some cases with pay.

Delgado College requires its students to participate in a three-semester credit environmental health practicum or internship training, normally completed during the summer after the first full academic year.

In lieu of writing a thesis, students at the University of Maryland must complete two summers' worth of internships. Mississippi State University requires a one-semester hour internship prior to graduation. The M.P.P.P.M. program at the University of Georgia considers its two units of internship an integral part of this professional curriculum. These students are required to complete one unit in a research or extension setting and one in an industrial or commercial setting.

Various other programs give students the option to complete an applied study program; among them are Central Technical Community College, the State University of New York at Farmingdale, North Carolina State University, Texas A & M University, the University of California at Davis, Berkeley and Riverside, among others. The reader is referred to Table 11 for more complete information.

G. Graduate Follow-up Strategies

Graduates are located in a variety of ways. One common, and surprisingly efficient, method is that of informal personal contact. In several instances there was no particular effort made to formalize the data collection methodology, and yet the information was found to be fairly complete. At the Pennsylvania State University individual faculty members take charge of locating their former students. The University of Rochester's toxicology program has an informal network of contacts among professional toxicologists at various centers around the country, and in that way officials learn where the graduates of their program find employment.

Ohio State University stays in touch with its graduates through correspondence and by attending professional meetings in common.

II. ADDITIONAL FINDINGS

A. Recruitment Techniques in Pesticide/Toxicology Programs

A number of factors influence prospective students to attend one academic program over another, recruitment being one. Toxicology programs at both the University of Cincinnati and Ohio State University find applicant numbers and quality high enough that no formal recruitment is necessary. Harvard University and the Pennsylvania State University are able to rely on their well-established reputations for adequate enrollment levels. Further, the University of Delaware, with the "second or third largest number of undergraduate majors in the United States", makes no conscious effort to attract additional students to its program. Harvard's program maintains its high level of interest among students from within the institution by way of informal contacts with interested students. Ohio State University notes a number of graduate students in toxicology as having migrated from the program in pharmacology. The chairman of the department at New Hampshire University lectures in various other of the science departments and finds that considerable interest is generated in this informal manner.

Contacts made in industrial settings and at national meetings are helpful in recruitment. That "word of mouth" mode of generating interest experiences varying levels of success, but it is relied upon quite heavily at the University of Maryland. Broward Community College, North Carolina State University, and Rutgers State University of New Jersey find they admit a significant portion of their students who learned of their offerings in this way. Rutgers successfully employs structured recruitment techniques; these include registry in the Peterson's Guide to American Colleges and Universities, sending brochures to interested persons, and descriptive displays placed in undergraduate departments at other institutions which have related programs. Two other institutions listed in the Peterson's Guide are the University of Rochester and the University of Cincinnati. Rochester augments this listing by contacting likely undergraduate students from within the institution and visiting them to discuss the graduate program.

Very commonly, brochures and bulletin board displays are forwarded to institutions which have undergraduate preparation in related areas. A source at the University of Cincinnati has indicated that a recruitment brochure is being developed at this time. The State University of New York at Farmingdale finds personal replies to students' requests for information to be effective; as is found to be true in many institutions.

Efforts to attract freshman enrollees ordinarily take two forms, the first being "Career Days" at high schools. This method is reported to experience a wide range of success levels, from "most helpful" at North Carolina State University, to "not effective" at Central Technical Community College. Not unlike the career day approach is that of official's visits to high schools and industries. Central Technical Community College prefers this method and reports it to be "very effective" for them.

No one method will be consistently effective in any given situation, just as was the case of one institution which was contacted for this review. Program sources were reported to have tried "everything" to recruit new students to their program, including: distributing brochures among high schools, offering to speak at high school assemblies, and personal contacts with students at junior colleges; all were met with negligible results. Those techniques were abandoned in favor of generating student interest from within the agricultural disciplines on campus, and with increased involvement with civic activities, such as 4-H. This approach has proven more effective for them. Overall, it was found that the first step in successful recruiting is to publicize and describe a program, and the second step is to have personal contact with potential applicants.

B. Research Funding and Sources of Student Financial Support

Data from Phase II indicate that the most prevalent form of financial assistance to graduate students is the research assistantship, and similar in-house work-study arrangements. Undergraduate students have a number of financial alternatives open to them including competitive academic/merit scholarships, loans (such as National Direct Scholarship loans), on campus work-study plans, and off campus co-op options. It has been observed that a number of students at the undergraduate level are self-supported by jobs unrelated to the academic community. Central Technical Community College reports that 20 percent of its students participate in a college work-study program, 10 percent receive Basic Educational Opportunity grants, 10 percent receive scholarships, and another 10 percent have loans from varied sources. Foreign students are very often receiving financial support from their native governments.

Graduate students have a much wider range of opportunities for receiving support than do undergraduate students. In Region VI it was reported that a number of EPA pesticide training grants are awarded each year. Sources identified the existence of other training grants which are sponsored by the National Institute of Environmental Health Sciences. As stated, the most widely received form of support is the assistantship. These funds come from a variety of sources, including the universities themselves, the Public Health Service, experimental research stations, extension services, and various other private funding agencies.

At Ohio State University all students receive stipends from the toxicology laboratories in exchange for part-time work in the research facilities. At the University of Georgia last year it was reported that only 17 percent of the graduate students were self-supporting, representing an increase in the number of students who are not receiving assistantships. Post- and pre-doctoral fellowships in amount exceeding $4000 per year, plus tuition paid, are awarded to all of the students enrolled in the toxicology program at the University of Cincinnati. The University fo Rochester offers stipends for student support which were sponsored by the National Research Service Award Program (an NIH program).

The pesticide industry awards outstanding graduate students at Rutgers - State University of New Jersey the Headlee Fellowship on a competitive basis. One respondent commented that in the instances, such as his own, where graduate student support is not available, the strength of these programs is significantly inhibited.

Research plays a key role in the training capabilities of any given program in any field. Students' opportunities are substantially enhanced by the wide variety of research projects which are being conducted at institutions around the country. The University of Iowa has one of three epidemiological study centers which are concerned with research of pesticides. Their Environmental Toxicology Section has been primarily concerned with the broad spectrum of pesticide usage. Research at the Section includes such topics as the relationship between pesticide intake and urinary excretion of pesticide metabolities, the estimation of personal absorption of pesticides during occupational exposures, the development of an identification system as an aid to physicians in the clinical management of pesticide poisoning cases, in addition to others. Funding for these projects comes from the Food and Drug Administration, from the Michigan State Health Department, from EPA, from the National Cancer Institute, from the Consumer Protection Agency, from the U.S. Department of Agriculture, and from the Center for Disease Control.

At the University of Cincinnati, research monies from EPA, the National Institute for Health, the National Science Foundation, and private concerns constitute the predominant source of faculty salaries for the Toxicology program. Research efforts include investigations on the development of infant animal models for the study of neonatal lead exposure; on neurophysical and neurochemical responses to heavy metals; on the metabolism and disposition of toxic substances with particular emphasis on halogenated hydrocarbons, including PCB's; on the nature of lung damage by sulfates; and the role of nutritional factors in toxicity.

Michigan State University's Pesticide Research Center is one of the United States Department of Agriculture's four "leader laboratories". It was founded on the "premise - and the promise - that research, particularly interdisciplinary research, will provide solutions to an extremely complex, interlocking series of problems." This facility is charged with the mission to examine agricultural chemicals which do not appear to be profitable to commercial concerns, but are important to the smaller farm operations.

Most of the research funding at Rutgers - State University of New Jersey is federal Hatch funds (i.e., United States Department of Agriculture - Cooperative State Research Services). MacIntyre-Stennis funds are available for research which is related specifically to forestry problems.

The University of Maryland provides ample opportunity for graduate research on its eight research farms and its Agricultural Experiment Station. Over two hundred research projects are currently being conducted at this institution in pesticide-related areas. Research projects on the mechanisms of action of indirectly acting anticoagulants and selenium metabolism and toxicity are funded by the National Institute of Health and the EPA at Ohio State University.

The University of Georgia has over thirty-five research grants from a variety of federal and private sources, including the Department of Energy, the National Institute of Health, the National Science Foundation, in addition to others. The Kresge Center for Environmental Healths provides Harvard University with research facilities and monies.

This description of research activities at the various institutions is in no way meant to be taken as comprehensive; rather, it is a sample of the nature of, and the funding sources for existing research projects.

C. Usage of IRIS and ERIC

ERIC and IRIS are federally maintained computer retrieval systems encompassing educational resource materials on a national scale. IRIS is an EPA generated compilation of information, and although its chief focus is potable water and wastewater, faculty sources in each program area were questioned regarding its use. Phase II was expanded to include an adjunct assessment of the utilization of IRIS and ERIC because the effectiveness of any such system can be measured by its application and use.

It should be pointed out that the respondents to the assessment question, "have you ever used ERIC or IRIS?", were in all cases faculty members rather than students. The findings in Table 7 should be interpreted accordingly.

TABLE 7

ERIC/IRIS UTILIZATION PROFILE - PESTICIDES

	Yes	No	Total Responding
ERIC	3	23	26
IRIS	3	23	26

One respondent reported access to a computerized literature search through its university library system. Oregon State University makes use of NTIS. Medlars, TOXLINE, and State University of New York computer services are utilized by Ohio State University's Toxicology program. TOXLINE is also employed by Environmental Toxicology at the University of Iowa. Reportedly, the toxicology program at the University of Cincinnati has access to a toxicology information abstract service.

Of all the environmental areas surveyed in Phase II (air, noise, pesticides, potable water, radiation, solid waste, wastewater, and energy), the following table depicts the total number of responses.

TABLE 8

ERIC/IRIS UTILIZATION PROFILE - PHASE II SUMMARY

	Yes	No	Total Responding
ERIC	72	307	379
IRIS	64	314	378

D. A Discussion of Program Flexibility

Phase II researchers, in an effort to compile data relative to the procedural, administrative, and developmental constraints in the modification of curriculum materials, posed the following questions to faculty members who were interviewed: "What is the time required to implement a complete change in a course?", and "What is the time required to implement a complete change in a program?". For the purposes of this study, a program is considered a course of study, either completely prescribed, or containing options, with an identity of its own, and with standard rules and procedures, the satisfaction of which leads to a degree, a certificate, or a diploma. A course is considered a unit of a program, in which a body of knowledge is presented, the satisfactory completion of which leads to the awarding of a predetermined or individually arranged number of credits.

These questions were asked of faculty members in each of the program areas described in this review. It was believed that a compilation of such information could provide useful and informative comparisons by degree level and by other related variables. It was also thought that this information would provide insights into the flexibility or lack of flexibility in the development and modification of courses and programs. This information holds interest to those considering the development of curricula, to those currently offering, but considering the modification of curricula, and to potential funding sources.

Responses to these questions are recorded for thirty of the thirty-four programs which are described in this volume. Time constraints for changes in both courses and in programs are a function of several variables. Many institutions report that they introduce new courses by way of offering them initially under the title "Special Topics" or "Special Problems". This permits them the opportunity to evaluate the effectiveness of the curricular materials used, and that of the mode of material presentation. Another factor which strongly influences the timing factor of course or curriculum changes in the date of the catalog publication. For instance, if the catalog goes to print in August but the changes are not agreed upon until September, then the changes would officially require eleven months; whereas, changes which receive approval in July could in many cases be effected in one month. Several institutions also have provision for individualizing programs to a given student's needs, and in this way they implement new programs prior to their being registered in print. Most respondents indicate that it requires from one month to one year for making changes in both course content and in program content.

The following tables present categorization of responses to the curriculum flexibility questions. Each responding program has one response recorded for each degree level. The responses are to be considered the best estimates of these faculty members of the time frames required to complete the changes under "normal" conditions.

TABLE 9

TIME REQUIRED TO IMPLEMENT A COMPLETE CHANGE IN A COURSE

Degree Program	Less than 1 month	1 month to 1 year	More than 1 year; less than 2	2 to 4 years	More than 4 years	Undetermined
Associate	1	3	1	0	0	0
Bachelor	0	8	3	2	0	0
Masters	0	7	3	3	0	1
Doctoral	0	6	3	0	0	0
TOTAL	1	24	10	5	0	1

TABLE 10

TIME REQUIRED TO IMPLEMENT A COMPLETE CHANGE IN A PROGRAM

Degree Program	Less than 1 month	1 month to 1 year	More than 1 year; less than 2	2 to 4 years	More than 4 years	Undetermined
Associate	2	4	0	0	0	0
Bachelor	0	8	1	0	0	0
Masters	0	10	2	0	0	1
Doctoral	0	6	1	0	0	0
TOTAL	2	28	4	0	0	1

E. Environmental Occupations

During the interviews for Phase II, faculty members were asked to identify the occupations which persons completing degrees in their programs would be qualified for. In order to verify data and establish consistency, respondents were subsequently mailed occupational checklists specific to their program area(s). These checklists asked them to indicate those occupations which graduates of their programs are qualified to fill. These components of the Phase II survey are summarized in this section.

Five programs at the associate level were identified and described as having options in pest control and/or plant protection. Program sources describe those persons securing the associate level degree as qualified for the following occupations:

- Pesticide Applicator
- Pest Control Operator
- Pest Control Inspector
- Pest Control Monitor
- Pest Control Technician
- Pesticide Sales and Service
- Application Supervisor
- Insect Rearing Specialist
- Regulatory Specialist/Technologist
- Structural Applicator
- Garden Center Management
- Agricultural Inspection Technician
- Field Laboratory Supervisor
- Field Equipment Technician
- Insect and Rodent Control Specialist
- Pest Management Specialist/Foreman
- Owner/Manager-Pest Control Firm
- Technical Representative for Chemical Manufacturer
- Weed District Superintendent

Associate level backgrounds also provide experience in research procedures, allowing graduates to function as research assistants and biological technicians.

Respondents indicate that graduates of bachelor's, master's, and doctoral level programs in entomology, pest management, and plant protection have the following occupational qualifications in common:

- Entomologist
- Field Laboratory Supervisor
- Insect Rearing Specialist
- Pest Control Monitor
- Agricultural Inspection Technician
- Environmental Monitoring Specialist
- Insect and Rodent Control Specialist
- Pest Control Technologist

Pesticide Applicator
Structural Applicator
Epidemiologist
Pest Management Specialist/Foreman
Regulatory Specialist/Technologist
Vector Control Specialist

Related occupations which were found to be appropriate, respective of the scientific nature of training in these programs, are:

Biological Technician
Environmental Monitor Specialist
Medical Technologist
Environmental Science Technician
Public Health Sanitarian/Inspector Engineer
Resource Conservation Technician

Graduates at all three levels commonly find employment with federal and state agencies, and with commercial and industrial firms.

The University of California at Berkeley prepares pest management specialists at the bachelor's level for employment with the USDA, the Forest Service, and the National Park Service. Graduates from North Carolina State University are qualified for occupations as County Extension Agents. New Mexico State University sources report their graduates are uniquely qualified Aerial Pesticide Applicators.

The graduates of the University of Maryland's master's level pest management curriculum have preparation for work as general practioners in the theory and practice of integrated pest management. Mississippi State University reports their graduates are capable Pest Control Consultants in private practice. At Texas A and M University master's degree recipients are considered capable for occupations in international development organizations, chemical and food processing industries, and agribusiness firms. The Master of Plant Protection and Pest Management program at the University of Georgia is intended to prepare its graduates for positions in industrial, extension, and regulatory agencies in plant pathology, entomology, and weed science.

Graduates of doctoral level programs very often remain allied with the academic community and join faculties of various colleges or universities for the purpose of conducting research and/or teaching. In addition, doctoral graduates find positions in local, state, and federal regulatory agencies, agribusiness, pest control industries, research firms and extension services.

Occupations which persons in the field of toxicology are prepared for are distinct from those in pest control, plant protection, or entomology. Delgado College offers an associate level program in urban pests management which prepares its graduates for employment in the field of epidemiology. These graduates have been successful in locating work in industrial, structural, institutional, right-of-way, public health pest control, and related fields.

Ohio State University provides a similar preparation at both its master's and doctoral levels, with the addition of Clinical and Environmental Toxicology. The University of Rochester's master's and doctoral programs in toxicology considers their graduates capable of teaching and conducting academic research, and of conducting industrial research on the toxic hazards of raw materials, intermediates, and by-products. A source from the University of Cincinnati's doctoral toxicology program reports graduates to be qualified to "investigate toxicity and to develop new methods for the evaluation of toxicity." Toxicology graduates at all levels find employment in government, consulting concerns and in academia.

F. Images of Environmental Programs Within the Institutions

Faculty members were asked to describe the images of their programs and other environmental programs within their institutions. A variety of responses were recorded with regard to their own programs. One source described the image of the program as "fair" and went on to say that most people do not relate well to pest control and do not understand the need for training programs of this particular kind. Another respondent estimated that a probable 70 percent of the students at their institution are not aware of the department's presence. Still another faculty member considered the overall image of his particular program to be "moderate".

In contrast to the rather neutral images experienced by those programs, both the University of Georgia and North Carolina State University feel they are well-received and that they enjoy excellent images within their respective acadamic communities. Most respondents felt that environmental programs in general have images which range from neutral to favorable.

G. The Need for Additional Curriculum Materials

North Carolina State University has identified the needs for materials dealing with the economics of pest management and also for introductory materials on the theories and plans of integrated pest management programs. Specific to their needs, they have developed their own laboratory notebook to accompany course work for the associate level program.

Curriculum aids which have been noted as lacking are entomology microfilms, audio-visual aids, and other audio-visual tutorial materials. One source commented that the textbooks which are in print are commonly at too sophisticated a level for the two-year programs, and an introductory entomology textbook would be extremely desirable.

Michigan State University has a grant from the National Science Foundation to develop teaching aids in pest management at the bachelor's level. Once these are completed, educators may find these aids very helpful.

H. A Discussion of Student/Graduate Communication and Financial Management Skills.

During Phase I, researchers noted that a large number of contacts felt that graduates are seriously deficient in the skills of oral and written communication, and to a lesser degree, those of financial management. During Phase II, faculty of the environmental/energy programs were questioned regarding their own attitudes on this subject in order to ascertain the consistencies or discrepancies in perceptions between academia and prospective employers of graduates.

With one exception, faculty members felt deficiencies in communication skills to be a problem. A program official at one institution cited increased Graduate Records Examination scores and improved credentials of applicants (at the graduate level) as the reason for stable/improved communication and financial skills. At the undergraduate level, however, the problem exists. Remediation of the deficits must come from the undergraduate curriculum outside of the program.

One source feels the communication problem is the result of inadequate practice in writing. Remediation in this instance takes the form of extensive report writing assignments and numerous essay style examinations. Another respondent felt that if their bachelor's program could be extended to last five years, instead of four, they would include course work in technical report writing. Additionally, it was expressed that the problem with designing remedial measures is in part due to the fact that industry has not indicated to program officials which professional skills it values. "Extreme concern" was expressed by one institution source. It is apparent to some that communication skills are inadequate now and that the situation is growing worse.

Two of the institutions indicated that they would like to require courses in technical writing and in business management, but they had no remediation programs in effect at the time of this report. At Central Technical Community College, students must take training in these problem areas. There is currently an effort to increase the requirements in communications, social science, mathematics, science, and personal development. Ohio State University feels that exposure to tutorials and group discussions sharpens their graduate students' communication skills. Doctoral students there must present a dissertation proposal for research funding and then, if funded, they must attend to all aspects of the project, including financial management.

I. Methods Utilized by Faculty for Keeping Current in the Field

Pesticide program officials responded to the question, "How do you keep current in your field?" most often by identifying affiliations with professional associations, and by participating in their regional and national meetings and conferences. One department chairman noted that he has access to and reads all of the faculty research papers which are written in that department. Reading these professional papers provides him with a reference of current literature on related research as well as keeping him informed of the developments in his own department. Carrying out first-hand research is cited as an excellent means for remaining abreast. Respondents identified a number of professional journals which they subscribe to. Three sources noted personal contact with professional colleagues at other institutions as being an important factor in staying alert to developments in other locales. Work in an agricultural extension service in one instance kept a source aware of commercial developments in field; as did consulting activities. Finally, instruction provides a means for faculty to stay well-versed in the current information in the pesticide and toxicological information.

III

A Summary Profile of Representative Educational Programs

The following footnotes (1-6) refer to the various column headings of the Table. Other footnotes are specific to the figures which were provided by various institutions and are used throughout the Table.

[1] Enrollment	1976-77 statistics
[2] Graduates	average for last three years; 'change' indicated apparent trends within that three-year period
[3] Employment	'other' includes positions such as those found within the educational community
[4] Faculty	full-time and part-time is determined by individual institutions
[5] Internship/Applied Study	part of an option to obtain a degree; may or may not have financial reimbursement connected with it
[6] Graduate Follow-up	a standardized procedure that enables the institution to periodically determine the employment of their graduates
NA	Not Applicable/Not Available
*Asterisk	denotes that a program appears in more than one volume of the profile

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	ENROLLMENT[1] PART TIME	GRADUATES[2] No. / YEAR	GRADUATES[2] CHANGE
CA	University of California - Berkely	Pest Management	B.S.	30		13	Up
	University of California - Davis	Environmental Toxicology	B.S.	42		22	Stable
		Plant Protection and Pest Management	M.S.	16		5	Stable
		Entomology	B.S. M.S. Ph.D.	75 50 20		12 5 3	Stable Stable Stable
	University of California - Riverside	Pest Management	M.S.	20		8	Up
DE	University of Delaware	Entomology and Applied Ecology	B.S.	60	10	10	Up
FL	Broward Community College	Pest Control Technology	A.S.	60(a)		5	Up
GA	Abraham Baldwin Agricultural College	Plant Protection	A.Ag.	0		0	Stable

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(a) Includes full- and part-time students.

11

PESTICIDES EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR									
	INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
90/10/NA	60%		20%	20%	0	29	X			X
90/10/NA	50%		50%		12	0	X		X	
70/20/10	80%		10%	10%	0	31	X			X
93/2/5	70%		20%	10%	24	0		X		X
40/40/20	70%		20%	10%						
40/40/20	20%		20%	60%						
80/10/10	N/A	N/A	N/A	N/A	12	24	X			X
70/30/NA	N/A	N/A	N/A	55%	8	0		X	X	
100/-/-	100%				0	6	X			X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES [2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
	University of Georgia	Entomology	A.B. B.S.	21		10	Stable
		Entomology	M.S. M.P.P.P.M. Ph.D.	32 2 25		13	Stable
IA	University of Iowa	Environmental Toxicology	Ph.D.	3		.5	Stable
LA	Delgado College	Urban Pest Management	A.S.	22		2	Stable
MD	University of Maryland	Pest Management	M.S.	8		2	N/A
MA	Harvard University	Toxicology	M.S. Sc.D.	N/A		.5	Stable
MS	Mississippi State University	Pest Management	M.Ag.	15(b)		4	Up
NE	Central Technical Community College	Agricultural Technology	Cert.	11		11	Stable
			1-yr. Dipl.	30		20	Stable
			2-yr. Dipl.	20		11	Stable
			A.A.S.	10		5	Stable
			A.S.	10		5	Stable

(a) Refers to industry and consulting combined.

(b) Estimated.

11

PESTICIDES EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	EMPLOYMENT PRIVATE SECTOR CONSULTING	EMPLOYMENT GOV'T	EMPLOYMENT OTHER[3]	FACULTY[4] FULL TIME	FACULTY[4] PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	INTERNSHIP/[5] APPLIED STUDY NO	GRADUATE[6] FOLLOW-UP YES	GRADUATE[6] FOLLOW-UP NO
90/10/NA	15%		30%	55%	16	0		X	X	
14/86/NA	8%(a) 100%(a) 19%(a)		62% 42%	30% 39%	16	0	X	X X	X X X	
20/70/10	17%	17%	33%	33%	4	0		X		X
95/5/NA	80%		20%		3	10	X		X	
95/5/-	N/A	N/A	N/A	N/A	5	0	X			X
N/A	12.5%		12.5%	75%	1	1		X	X	
90/8/2	40%	40%	20%		0	11	X		X	
95/5/-	80%	10%	10%		4			X	X	
95/5/-	80%	10%	10%				X		X	
95/5/-	80%	10%	10%				X		X	
95/5/-	80%	10%	10%				X		X	
95/5/-	80%	10%	10%				X		X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

				ENROLLMENT[1]		GRADUATES[2]	
STATE	INSTITUTION	PROGRAM	DEGREE	FULL TIME	PART TIME	No. / YEAR	CHANGE
NH	University of New Hampshire	Entomology	B.S. B.A.	35	1	5	Up
NJ	Rutgers-State University of New Jersey	Biology/ Entomology	B.A. B.S.	13	0	3	Stable
		Entomology/ Economic Zoology	M.S. M.P. Ph.D.	26	4	3	Stable
NM	New Mexico State University	Pest Management	B.S.	27		4	Up
NY	State University of New York at Farmingdale	Pest Control Technology	A.A.S.	25	1	18	Stable
	University of Rochester	Toxicology Training	M.S. Ph.D.	4 22		2 5	Up Up
NC	North Carolina State University	Agricultural Pest Control	A.A.Ag.	20		11	Stable
		Pest Management	B.S.	22		4	Up

(a) Refers to farming.

(b) Refers to industry and consulting combined.

(c) Estimated.

11

PESTICIDES EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
66/33/NA	50%(b)		48%	2%	0	9		X	X	
70/30/NA	70%		30%		22			X	X	
70/30/NA	70%		30%					X	X	
80/2/18	80%		20%		8	4		X		X
95/5/NA	50%		50%		4	15	X		X	
25/50/25 30/60/10	33%	33%	33%		0	20		X	X	
90/10/-	60%	5%	5%	30%(a)	0	40	X			X
99/1/-	40%(b)(c)		10%(c)	50%	1	40		X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES[2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
OH	Ohio State University	Toxicology	M.S.	0	1	1	Up
			Ph.D.	7		1	Up
	University of Cincinnati	Toxicology	Ph.D.	20		3	Up
OR	Oregon State University	Pest Management	B.S.	30		30	Up
		Botany and Plant Pathology	M.S.	36		12	Up
PA	The Pennsylvania State University	Entomology	B.S.	15		2	Up
			M.Ag.	1		0	Up
			M.A.	24		4	Up
			Ph.D.	10		1	Up
	University of Pittsburgh	Environmental Health	M.S. M.P.H.	40		12	Stable
		Engineering/ Industrial Hygiene	D.S. Ph.D.	19		3	Stable
TX	Texas A & M University	Entomology	B.S.	36		9	Stable
		Entomology	M.S.	6		2	Stable
			M.Ag. Ph.D.	6		2	Stable
UT	Utah State University	Pest Management	B.S.	10		5	Stable
			M.S.	10		4	Up
			Ph.D.	6		1	Up

11

PESTICIDES EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY^{4}		INTERNSHIP/^{5} APPLIED STUDY		GRADUATE^{6} FOLLOW-UP	
	PRIVATE SECTOR									
	INDUSTRY	CONSULTING	GOV'T	OTHER^{3}	FULL TIME	PART TIME	YES	NO	YES	NO
100/-/-	30%	10%	20%	40%	1	0		X	X	
66/33/-	40%		10%	50%	8	0		X	X	
60/40/NA	35%		25%	40%	9	29		X		X
20/80/NA	35%	20%	25%	20%	8	30		X		X
100/-/NA 50/50/NA 50/50/NA 50/50/NA	20%		40%	40%	1	19		X		X
67/33/-	N/A	N/A	N/A	N/A	16	24	X			
99/1/NA	65%	5%	20%	10%	32	27		X	X	
75/25/NA	30%	15%	45%	10%			X		X	
20/80/NA	50%		50%		12	0		X		X
20/70/10	50%		40%	10%	12	0		X		X
20/70/10	20%	20%	10%	50%	12	0		X		X

Photo reprinted from the
Michigan Technological
University Catalog 1975-76

PROJECT COMMENTARY

Photo reprinted from the
University of Missouri,
Columbia Bulletin 1977

PROJECT CONSTRAINTS

In preparation for the on-site interviews, all of the institutions' catalogs were intensively reviewed in order to determine where environmental programs were being offered. During the course of this study, 171 institutions were visited and a total of 338 environmental programs, representing 45 states and Washington, D.C., were surveyed in detail. Albeit significant, these programs represent only a portion of all such programs available and cannot be construed as an in-depth survey of all environmental programs. It is, however, a representative sample within each of the environmental pollution control areas of Air, Noise, Pesticides, Radiation, Water and Wastewater, Solid Waste and Energy.

Several constraining factors to the proposed comprehensiveness of the study were encountered while collecting data from the institutions. It was disappointing to find that definitive records or statistics were generally unavailable which would describe specifically the placement of environmental program graduates. General indications of placement within categories, such as government or industry, were often available in percentages only. Depending on the size of the program and its age, some contact people could describe all graduates, others knew only where the past year's graduates were presently employed, and still others were aware only of their advisees entry-level positions and subsequent moves.

It also became clear during the on-site interviews that some programs of similar or identical content had different titles. This lack of clarity within the environmental areas serves to confuse the casual reader. For that reason, attention must be directed to the actual environmental course listings included in each program summary.

A list of terms commonly used during the on-site interviews and subsequently in this report was developed in order to facilitate precise data gathering. The reader is directed to Appendix II, TERMINOLOGY.

No attempt was made, in this report, to qualitatively judge any of these programs. The apparent absence of substantial qualitative measures in the environmental education field in general and the desire to collect data in a neutral atmosphere underscore the reasons for this omission. It appears that there is a need for the development of an environmental program model in each of these areas in order that some qualitative standards be provided where none now exist.

PROJECT COMMENTARY

This report describes training programs which are located in 20 states and offered through 26 distinct institutions. Students may find programs which offer credentials ranging from certificates of attendance to doctoral degrees.

A total of 924 full-time students are enrolled in the sum of the programs reported on; 147 at the associate level, 416 at the bachelor's level, and 240 at the master's level, and 121 at the doctoral level. Two hundred and fifty-one full-time and 369 part-time faculty conduct these programs.

Researchers learned that at the associate level 95 percent of the students come from within the state; at the bachelor's level 75 percent come from within the state. A further decline in in-state enrollment in master's programs to 56 percent can be seen (with foreign student enrollment of 7 percent), and at the doctoral level 41 percent are in-state students. Noted also was that in the private institutions the in-state enrollment figures for advanced degrees are substantially lower than those given for national percentages.

Only five of the curricula were described as having mandatory internships, but another eight offer applied study options. In all cases where these options exist, students are strongly advised to participate. Seldom do associate level students receive financial help, but when they do, the aid is most often in the form of a work-study arrangement. Bachelor's students have a greater degree of flexibility with scholarships, work-study, co-op plans, and loans available to them. Advanced degree students receive funds more often than not, and, in most instances, they are in the form of an assistantship.

Research projects are primary in importance when considering any type of advanced degree. In one instance cited herein, research monies provide the salaries of virtuallly all of the faculty. Further, research projects determine in many cases the nature of the student enrollment by providing financial assistance for them in exchange for work on a particular research endeavor, and in that way provides doctoral and master's research topics. Research brings departments the technical equipment necessary for the conduct of projects and thereby sets parameters for research capabilities.

While many schools have no need for expending recruitment efforts, a still larger proportion of the institutions utilize various structured or unstructured means for generating interest in their programs. A sampling of such methods includes: posting descriptive materials at other institutions, involvement in civic activities, lecturing in institutional departments other than those related to toxicology or pesticides, and by contacting students who display ability in introductory level courses.

Figures describing the employment history of graduates are presented in this report. Data show that graduates of doctoral programs return to the academic community at a rate of 31 percent. Fifty-four percent of the master's graduates are employed in the private sector, 27 percent in government, and 15 percent return to academia. Most commonly bachelor's graduates find employment in the private sector, i.e., 48 percent, and associate graduates are most likely to be employed in the industrial sector with commercial pest control agencies. In some instances employment data were estimates, in others data were collected by way of follow-up studies being conducted. Commonly graduates are located through an institution's alumni association by way of questionnaire. Frequently follow-up data are collected casually through personal contact and informal though the method may be, data of comparable completeness is often available.

Phase II researchers asked program sources to address the question of the future of pesticide and toxicology programs in particular and that of environmental programs in general. Regarding pesticide and toxicology programs, it was felt that the outlook for persons having this training will remain very bright for at least the next four to five years. As previously noted, the workforce availability is far more limited than is the number of positions which are open. Environmental toxicology is described as a "burgeoning field" and the existing training and interest in pesticides and related topics are considered excellent. Many sources project the growth of pesticide and toxicology programs at all levels in response to the increasingly technical nature the fields fo pest and toxic substance management. Only one source at the associate level described the field of pest management as having low job availability and poor salaries.

Areas which program officials feel need greater coverage are integrated pest management, food and fiber, general pest control, and a greater quantification and specialization with regard to the use of all agricultural chemicals. An increasing number of growers are realizing that chemical pesticide usage is not necessarily the most effective mode for limiting pest populations, in addition to being an extremely expensive method for control, and would find the dissemination of integrated pest management information useful.

Regarding environmental programs broadly, sources consistently indicate the need for education programs which provide instruction in the necessary technology for the care of the earth, but caution that the future lies in the level of governmental fiscal commitment. An official of the first rural toxicology program in the Western Hemisphere perceives past federal action on the problem of toxic substances' use as being much like trying to use a "sledgehammer to drive a tack," i.e., inappropriate. The same individual feels strongly that the general population needs to be reminded of the seriousness of environmental matters, and that we "presently need a shot in the arm like Rachel Carson and Earth Day gave the movement in the late 60's."

LIST OF PESTICIDES TRAINING INSTITUTIONS BY DEGREE

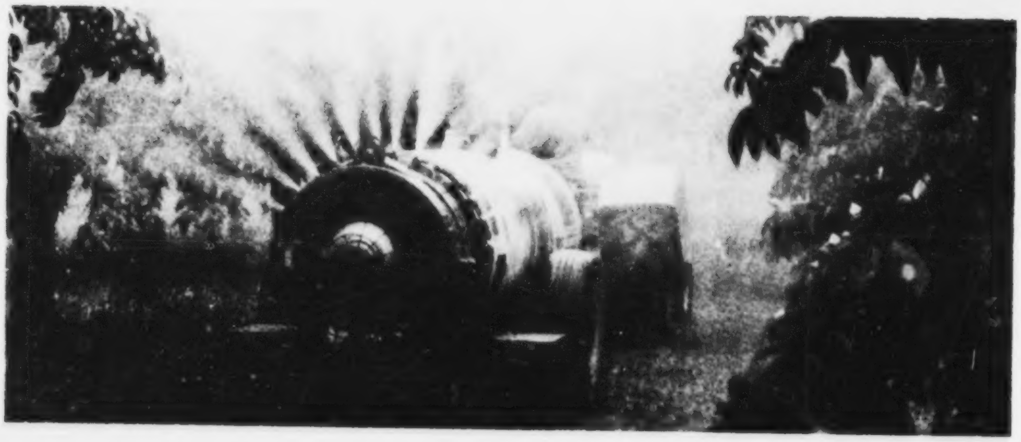

Photo reprinted from the
EPA Journal October, 1976

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PESTICIDES

TRAINING SUMMARIES

Photo reprinted from the
Marquette University Bulletin
1977-78

INSTITUTION: ABRAHAM BALDWIN AGRICULTURAL COLLEGE (ABAC)

PROGRAM: Plant Protection

DEPARTMENT: Division of Agriculture

DEGREE: Associate in Agriculture

CONTACT: Dr. Francis McCain
ABAC Station
Division of Agriculture
Tifton, Georgia 31794
(912) 386-3255

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Responding to increasing demand for qualified plant pest control operators, this program was organized during 1972. The objective was to extend the traditional function of pest control operators, who usually confine their efforts to the control of urban and industrial pests, to include custom treating for the control of any insect, plant disease, weed or other pest. The curriculum in Plant Protection was designed to provide a sufficiently broad technical knowledge essential to supplying satisfactory pest controls to the agricultural industry.

Faculty and courses were aligned and the curriculum was printed in the catalog, but no students ever enrolled in this option. This is in part due to funding levels, which would permit neither advertisement of the program nor recruitment for it. As of the fall of 1977, the program has been terminated and removed from the catalog. Six courses dealing with pest management are now offered in the Agri-Science Technology program.

PROGRAM REQUIREMENTS

The initial program required one hundred and five quarter hours of specified coursework, fifteen of which consisted of a cooperative work experience. Fifteen hours of general core courses from the humanities, mathematics, and physical education were required; the remaining hours consisted of prescribed plant protection courses.

CURRENT FACULTY, STUDENTS, GRADUATES

No faculty have ever been specifically assigned to this program, however it was felt that the expertise was sufficient among the existing agricultural staff to teach courses had it become necessary.

Neither has a student ever enrolled in this curriculum. At ABAC the mode of introducing new degrees is to first design the program and include it in the catalog; second, wait for students to become interested in pursuing that particular option and indicate such an intention by enrolling; third, allocate funds based on the level of student interest; and finally, to identify appropriate faculty and facilities in order to begin offering courses. This sequence insures a lack of commitment on the part of the student and reinforces the offering as being speculation rather than intent.

PROGRAM PROJECTIONS

There are no plans for attempting to offer this Plant Protection Option again. The six electives will continue to be offered sporadically. It was reported that if a new attempt were made to offer an option in plant protection, funding would have to be firm and cooperation with industry established.

COURSE DESCRIPTION

Plant Protection Option course requirements:

AEN 170 Pest Control Equipment - Basic understanding and skill in metal work. Selection, use and care of materials and tools. (5 q.h.)

AEN 120 Plant Identification - Identification, adaptation, and use of ornamental and crop plants. (5 q.h.)

AEN 220 Fertilizers and Soils - Soils found in the Coastal Plain. Fertilizer materials and treatment necessary for high crop yields. (5 q.h.)

AEN 223-224 Weed Control I & II - Economically important weeds and how they are controlled. (5 q.h. each)

ENT 201-202 Insect Control I & II - Classification, identification and control of insects. Structure, function, feeding and life cycles of insects. (5 q.h. each)

ENT 105 Toxicology - Effects of pesticides on pests. (5 q.h.)

ENT 150 Pesticides - Composition, formulation, correct usage, precautions and antidotes of common pesticides. (5 q.h.)

ENT 203 Environmental Quality - Pests relationship to the environmental quality of man. Water, air, and food pollution through the use of pesticides. (5 q.h.)

PAT 221-222 Disease Control I & II - Structure, life cycles, classification and identification of plant disease organisms and how they are controlled. (5 q.h. each)

Agri-Science Technology pest control-related electives:

AGY 125 Control of Weeds, Insects and Diseases - Embraces principles of insect, disease and weed control in production of field and horticultural crops. (5 q.h.)

AGY 201 Plant Science - Basic principles and theories involved in field crop production. (5 q.h.)

AGY 223 Weed Control - Life cycles, identification, and control of economically important weeds. (5 q.h.)

ENT 201 Insect Control - previously described.

PAT 221 Plant Disease Control - Previously described.

PPC 101 Plant Pest Control - Composition, formulation, usage, and application of pesticides. Water, air, and food pollution through use of pesticides. (5 q.h.)

INSTITUTION: BROWARD COMMUNITY COLLEGE

PROGRAM: Pest Control Technology
DEPARTMENT: Division of Mathematics and Science
DEGREE: Associate of Science in Pest Control Technology

CONTACT: Mr. Dudley Palmer
Head of Pest Control Technology Program
Broward Community College
3501 S.W. Davie Road
Fort Lauderdale, Florida 33314
(305) 581-8700

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This two-year program was first implemented in 1971, with the assistance and support of an industrial advisory board. The curriculum is a combination of general education, pest control technology, and business administration. Emphasis is placed on the control of general household pests, termites and other wood destroying organisms, public health pests, and pests of landscape plants and turf. Pesticide safety and alternatives to pesticide usage are also stressed within this curriculum.

Occupations for which students are trained include pest control technician, technical research assistant, technical representative of a chemical manufacturer or supplier, and owner and/or manager of a commercial pest control firm. Graduates are eligible to apply for the Florida State Division of Health Examinations in all pest control categories.

Available to students and faculty are spray equipment and extensive slide and insect collections. Within close proximity are the University of Florida Agricultural Experiment Station and an office of the U.S. Department of Agriculture.

PROGRAM REQUIREMENTS

Any student accepted by the college must have a high school diploma or have earned a high school equivalency diploma. The curriculum consists of sixty-nine semester hours of credit, including twelve in general education, twenty-eight in the major field, ten in landscape technology, fifteen in business administration, and four in physical education. All students participate in field service during the summer and final term, being placed in full- or part-time positions with the pest control industry for academic credit and, in some case, for pay. Field trips are often scheduled within specific courses.

There are no special sources of student financial support for this program. Any student in the college may apply for available loans, grants and scholarships.

CURRENT FACULTY, STUDENTS, GRADUATES

One college faculty member is responsible for the administration of the pest control technology program, and teaches several of its courses. Additionally, approximately five persons in the pest control industry regularly teach courses in the curriculum.

An estimated sixty students are currently enrolled in the program. A large portion of these are part-time students, taking courses at night while working full-time in the pest control industry. Many are not degree-seeking students, but are attempting to earn the twenty credits required in order to take state certification examinations.

In recent years, an average of five persons has graduated from the program annually. While many are already employed in the field, a large portion open their own firms subsequent to graduation. Several have continued their educations, in the field of business administration. According to sources, no graduate has had difficulty securing employment in the field. Few have entered the public sector.

PROGRAM PROJECTIONS

A major program goal is to continue and expand the involvement of the local pest control industry. This participation was extremely helpful in the initial formation of the program, and college officials believe that expanded industrial involvement will strengthen the curriculum, recruitment, the field service program, placement of graduates, and the image of the program within the community. This cooperation may facilitate an upgrading of the industry, which now is typified by low pay, high turnover, and often low skills.

If carried through as planned, the increasing industrial support could lead to a doubling of enrollment within several years. As a result, a much needed full-time instructor/administrator position could be obtained.

A high priority in the future will be to offer continuing education in the form of short courses and seminars for municipal and industrial persons in pest control who are not seeking degrees. Courses presently offered will be divided into units for this purpose.

ADDITIONAL INFORMATION

Sources indicate that there is a strong need for a general entomology textbook for the two-year level; those entomology books that are available are written for students of a higher academic level.

COURSE DESCRIPTION

PCT 101 Economic Entomology - An introduction to the natural history, classification, habits, anatomy, and development of insects and their relatives. Emphasis on those of pest control significance. Includes survey of control practices. (3 s.h.)

PCT 121 Pesticides - The classification, mode of action, toxicity, mixing, registration, and safe application techniques used in the pest control industry. (3 s.h.)

PCT 151 Insect Identification - The systematic identification of insects and other animals of pestiferons and biological importance to the horticultural and structural pest control industries. (3 s.h.)

PCT 201 Field Service I - Summer, full-time, on-the-job work experience with a pest control firm doing business in all categories. At least 30 hours per week for 6 weeks. (3 s.h.)

PCT 211 Household Pests and Control - A practical approach to the identification, biology, life histories, inspection procedures, and control involving general household pests. (4 s.h.)

PCT 217 Seminar - Analysis of selected current problem areas in pest control and related subjects. (2 s.h.)

PCT 251 Wood Destroying Pests and Their Control - A practical approach to the identification, biology, life history, detection and control of termites, beetles, and fungi which destroy wood in structures. The operation and selection of tools and equipment are demonstrated and described. (4 s.h.)

PCT 261 Pest Control Business Administration - Studies in the basic nature of pest control services: site selection, business and labor management, production, cost analysis, insurance, laws, taxation, and other business methods as they relate to the pest control business. (3 s.h.)

PCT 271 Advanced Field Service - One term of part-time employment with a pest control firm doing business in all categories. At least 12 hours per week for 15 weeks. Research projects and written reports required. (3 s.h.)

INSTITUTION: NORTH CAROLINA STATE UNIVERSITY

PROGRAM: Agricultural Pest Control

DEPARTMENT: Agricultural Institute

DEGREE: Associate in Applied Agriculture

CONTACT: Dr. H.B. Craig, Associate Director of Academic Affairs
and Director of the Agricultural Institute
School of Agriculture and Life Sciences
North Carolina State University
Raleigh, North Carolina 27607
(919) 737-2748

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This two-year pest control program was organized at the Institute's inception in 1959. While the program currently focuses chiefly on agricultural pest control, graduates of the program are considered qualified to become commercial pest control operators, research technicians, and state pest control inspectors. Agriculturally related career opportunities include agricultural chemical sales and service, custom application of agricultural chemicals, and farming.

Instructional programs of the Agricultural Institute are organized and conducted as part of the over-all resident instruction program in the School of Agriculture and Life Sciences. The departments of Crop Science, Entomology, Horticultural Science and Plant Pathology share faculty and facilities with the two-year pest control program. Available to the students are extensive laboratory facilities, climatically controlled rearing rooms and greenhouses where organisms, insects, weeds and their hosts can be grown and studied. Nearby farms have facilities for both teaching and observing how technology is applied. Program instructors have developed a laboratory notebook for students in this program, and provide to students detailed course outlines.

PROGRAM REQUIREMENTS

In order to enter this program, all prospective students must have a high school diploma or have passed the Certifying Examination of the North Carolina Department of Public Instruction. Structured into the curriculum are twenty-three semester credits of general requirements in areas such as general mathematics, English, economics, sociology, and physical education. Forty-one credits of major required courses are in fields such as animal science, crop science, entomology and plant pathology. Seven hours of elective courses may be selected from all courses offered by the institute.

Field Laboratory sessions on university farms and field trips to commercial facilities provide students with practical observation. In addition, many students spend at least one semester working in commercial firms, hospitals or on campus for credit. Many students are placed in part-time summer employment positions in the pest control field for pay.

Other financial aid available includes scholarships, grants, and loans, which are awarded based on need.

CURRENT FACULTY, STUDENTS, GRADUATES

Forty faculty members and ten teaching assistants from the four associated departments and other related departments of the school contribute to the Agricultural Pest Control curriculum. None of these work full-time with the program.

Currently twenty students are enrolled in the program. Although many students have entered immediately following high school graduation, a number of veterans are also accepted. Eight to twelve students and graduates has remained relatively stable as the State Legislature has set limits on the number of students that can be accepted. The institute is currently carrying the maximum number that is allowable.

Although this program is designed to be terminal, a small percentage of students seek further schooling upon graduation. Those that seek employment are assisted by the school's placement office and by professors. Officials are unaware of any graduates that were not successful in securing employment. While at least one-third of the graduates return to farming, many of the remaining job-seekers become employed as owners or supervisors in commercial pest control firms.

PROGRAM PROJECTIONS

As limits are set regarding student enrollment, significant growth in the faculty and student population is not expected to occur. Changes in the curriculum itself are not anticipated unless as yet unforeseen needs occur.

COURSE DESCRIPTION

General Requirements:

AC 11 and 12 Agricultural Communication I and II - AC 11 is designed to improve the students ability in grammar, spelling and oral communication. AC 12 offers a business approach to letter and report writing, a review of mass communications, and an evaluation of the quality and importance of information distributed through different types of mass media. (6 s.h.)

AG 116 Agricultural Orientation - Orientation to the university campus and North Carolina agriculture. (1 s.h.)

BAE 11 Agricultural Calculations - Practical or applied calculations; measurement of lengths, areas and volumes; decimals, proportions, ratios, graphs, equations and averages. (3 s.h.)

EB 12 Economic Organization of Agriculture - The organization and operation of our economic system. Economic forces determining the level of prices, production and consumption, role of firms, households and government in economic decisions. (3 s.h.)

EB 21 Agribusiness Accounting - Basic principles of double entry accounting including use of ledgers, journals and financial statements. Payrolls, business taxes, inventory control and cost analysis. (3 s.h.)

SOC 51 Community Leadership - The community and changes in community living, including several major problems in citizens' efforts to raise levels of living. Successful action programs, the importance of trained leaders and methods of leadership development. (3 s.h.)

Major Requirements:

VET 62 Livestock Diseases - The basic nature of disease processes, their causes, recognition, and dissemination. Emphasis on methods for disease control. (3 s.h.)

BAE 10 Tools and Materials - Materials, tools and tool processes used in the construction, repair and maintenance of farm utilities and labor-saving devices. Students involved in a variety of manipulative activities. (2 s.h.)

CS 11 Crop Production - The major crops of the southeastern U.S. Effects of culture and analysis of problems which affect the profitability of crops, breeding and seed certification and management practices. Classroom and laboratory. (4 s.h.)

CS 52 Weed Control - Practical weed control procedures for major North Carolina crops and discussion of serious perennial weeds. Control of woody plants, aquatic plants, and weed control around the home. Also, weed control chemicals, equipment and identification of weeds. (3 s.h.)

EB 51 Agricultural Business Management - Basic principles in operating an agricultural business. Analysis of problems which affect profitability of farm operations. (3 s.h.)

EB 61 Agricultural Policy and Programs - Processes of policy formation in a democratic society and the role of the individual and group actions in the development of public programs. (3 s.h.)

ENT 10 General Entomology - Discussion of how insects live, their external and internal structures with their function, how they are classified and identified, and their control. (3 s.h.)

ENT 21 Agricultural Chemicals - Practical information on chemicals, including laws, influence on humans and environment, formulations and first-aid. Safety procedures and application equipment. (3 s.h.)

ENT 72 Vertebrate Pests - Life history, habits and control of vertebrate pests such as rats, mice, birds, snakes, squirrels, moles and bats. (2 s.h.)

ENT 90 Pest Control In Today's Environment - Current developments in pest control, including relationships between environment and pest control, pesticide laws, custom agricultural pest control and the future of pest management. Guest speakers present each topic. (1 s.h.)

FOR 52 Small Private Forest Management - Growing, harvesting and marketing timber products under small private ownership. (3 s.h.)

PP 52 Plant Diseases - Major causes of diseases in plants, including bacteria, fungi, nematodes, viruses, and parasitic seed plants. (3 s.h.)

SSC 12 Soil Management - Fundamental soil physical and chemical properties which most affect soil and crop management decisions. (4 s.h.)

SSC 51 Fertilizers and Soil Fertility - Factors influencing soil productivity with emphasis upon fertilizer materials, including the impact of technological advances upon fertilizer production, formulation and application. (3 s.h.)

INSTITUTION: STATE UNIVERSITY OF NEW YORK AT FARMINGDALE

PROGRAM: Pest Control Technology
DEPARTMENT: Biological Technology
DEGREE: Associate in Applied Science (A.A.S.)

CONTACT: Dr. Harvey E. Barké
Chairman, Biological Technology
State University of New York
Melville Road
Farmingdale, New York 11735
(516) 420-2175

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Pest control technology is a second year option in the Biological Technology program. This program, which originated in 1947, provides students with a basic foundation in the sciences such as chemistry, biology, botany, and zoology.

Although the program is considered to be terminal, it also prepares students for continuation of their education in the same or similar areas of study. Many colleges and universities grant two full years of credit for this program. An optional internship is part of the final semester of the program in which students are placed in part-time jobs with commercial arborists, exterminators, and pest control operators.

Opportunities exist for graduates in the pest management field in positions such as pesticide salesman, custom spray operator, pest control operator, environmental control technician, and pesticide screening research technician.

PROGRAM REQUIREMENTS

Admission to the program requires that an applicant have a high school diploma or its equivalent.

Requirements for the Associate degree include completion of sixty-five credits of course work. This includes at least seventeen credit hours in the basic biological technology program and a minimum of thirty-one credit hours in the pest control option. Required are courses in medical entomology, ecology, weed control, mycology and plant pathology, industrial pest control, and pesticides and field research procedures.

CURRENT FACULTY, STUDENTS, GRADUATES

There are four full-time faculty members directly involved in the pest control option. Faculty members are assigned to Biological Technology, however, and not exclusively to one area or program option. In this respect the pest control program utilizes the services of all nineteen full-time faculty in the Biological Technology program. The nineteen include thirteen Ph.D.'s and six technical assistants. This program usually has five to seven adjunct members on a part-time basis. No faculty member is specifically assigned any research, but most do some research on their own time.

Currently, enrollment in the pest control option consists of twenty-five full-time students and one part-time student. Approximately 95 percent of the students are from New York and are recruited through industry contacts of faculty, from other programs within the college, or at high school career days. Many students receive some form of financial assistance from various sources such as the College Work-Study Program, industry scholarships and research grants, and environmentally concerned organizations.

An average of about eighteen students graduate each year in the pest control option. In 1977 there were only fourteen graduates but program officials anticipate there will be twenty-four in 1978. A large number of graduates, about 75 percent, continue their education in four-year programs, usually in the same or related field. Graduates going directly into the workforce have little trouble finding employment and work both in private industry and government agencies. Placement is done primarily through faculty contacts, recruitment by companies, and the university's placement service.

PROGRAM PROJECTIONS

Officials hope to expand the program and possibly offer an Associate in Science (A.S.) degree which they believe will be more beneficial for students transferring to four-year programs at various schools throughout the country. An additional three faculty members are anticipated for the 1978-79 school year, primarily replacing retiring members.

ADDITIONAL INFORMATION

In addition to the academic program on campus, the program also does training for pesticide applicator certification in New York and offers a two-week course for the Veteran's Administration, conducted in VA hospitals throughout the country.

COURSE DESCRIPTION

SC 100 Applied Entomology - This course is intended for people interested in custom spray work and aboriculture. This course should aid materially in the qualification of people as licensed spray men. (3 s.h.)

SC 136 Botany - Fundamentals of plant science with particular reference to sea plants; morphology, anatomy, physiology, reproduction and genetics of plants. (4 s.h.)

SC 108 Entomology - The nature, structure, growth, habits, and injurious effects of insects and related forms. The identification of common plant pests, diseases, and their injuries in the field. Control measures and application equipment. (3 s.h.)

SC 201 Medical Entomology - The study of insects and other arthropods that annoy man and animals, transmit diseases, and contaminate stored products. (3 s.h.)

SC 204 Entomology II - The identification and control of pests and diseases of plants grown under glass, using latest chemical materials and control equipment. (3 s.h.)

SC 205 Mycology and Plant Pathology - The study of fungi and nematodes; their culture, isolation, identification, life cycles, injuries, and control. (3 s.h.)

SC 212 Weeds and Their Control - The classification and identification of weeds harmful to crop culture. Field study is stressed. (3 s.h.)

SC 238 Industrial and Household Pests - Biology and control of fabric, wood and stored grain pests will be stressed. Fundamentals of the pest control business and the responsibility to the public will be covered. (3 s.h.)

SC 241 Environmental Protection I - Survey and analysis of pollutants in the water environment. Survey and analysis of pesticides in the environment. (3 s.h.)

SC 242 Environmental Protection II - Continuation of SC 241. (3 s.h.)

SC 208 Field Research Procedures - (4 s.h.)

SC 115 Plant Physiology - (3 s.h.)

INSTITUTION: CENTRAL TECHNICAL COMMUNITY COLLEGE (CTCC)

PROGRAM: Agriculture Technology

DEPARTMENT: Agriculture Technology

DEGREE: Associate of Applied Science
Associate of Science
One-Year Diploma, Two-Year Diploma
Certificate of Achievement

CONTACT: Mr. Dean Blaha
Chairman, Agriculture/Environmental Technology Division
Central Technical Community College
Box 1024
Hastings, Nebraska 68901
(402) 463-9811

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Agriculture Technology program at Central Technical Community College provides training in the use and control of pesticides. The Associate of Applied Science degree prepares students for pesticide sales and service, weed district superintendencies, experiment station technician positions, farm supply, business management, garden center management, and pest control employment. The graduate with a two-year diploma may seek employment as a fertilizer blender operator, grain storage fumigator, seed handler, soil conservation aide, custom pesticide handler, or in farm supply and sales. The one-year diploma is designed for the student desiring skill development in one specific segment of agriculture; emphasis is given to learning specific operational skills for handling pesticides.

Since its inception in 1973, the CTCC program in Agriculture Technology has sought to produce trained, certified personnel in selected areas. Curriculum expansion and revision follow changes in government pesticide application regulations. Previous EPA grants enabled CTCC to upgrade training of weed district superintendents and grain operators, but the progressive decline in tuition monies available from EPA has contributed to lowered enrollments in this program.

An extensive stock of audio-visual materials (tapes, films, etc.) supplements the student's hands-on experience with various farm machines. Central Technical's Agriculture Technology students farm 260 acres and maintain the college's eighty-acre campus and three-hole golf course.

PROGRAM REQUIREMENTS

Team-teaching, joint faculty evaluation of students' work, and the flexibility and individualized instruction of an open-enrollment plan which allows entrance into the program any day of the school year are features of the Ag Tech program. Students must have a high school diploma or its equivalent for admission.

The requirements for completion of the various degrees offered in Agriculture Technology vary in number of hours and curricular concentration.

Associate of Applied Science

43 qrt. hours, major occupational area
9 qrt. hours, related occupational area
12 qrt. hours, optional occupational area
30 qrt. hours, general education

94 qrt. hours required

Associate of Science

47 qrt. hours, occupational area
47 qrt. hours, general area

94 qrt. hours required

Two-Year Diploma

60 qrt. hours, major occupational area
7 qrt. hours, related occupational area
12 qrt. hours, optional occupational area
15 qrt. hours, general education

94 qrt. hours required

One-Year Diploma

39 qrt. hours, major occupational area
9 qrt. hours, general education

48 qrt. hours required

Certificate of Achievement

variable hours

CURRENT FACULTY, STUDENTS, GRADUATES

Four full-time instructors serve the eighty students enrolled in Agriculture Technology. (Approximately one-third of the students are women.) The number of graduates annually has remained consistent, and no fluctuation is anticipated. Figures for degrees awarded vary by degree level: 10-12 certificate; 20 One-Year Diplomas; 10-12 Two-Year Diplomas; 5 Associate of Applied Science; and

5 Associate of Science. Approximately 25 percent of the students return to CTCC for more coursework, but few pursue four-year degrees.

Faculty contacts with industry place most graduates and account for an overwhelming percentage of students employed in the private sector upon completion of coursework (90 percent). Approximately 80 percent are hired in their respective fields. Statistics are difficult to generate given the open-enrollment plan, but class lists indicate a steady increase in the number of students pursuing an Agriculture Technology curriculum. Many enrollees are Nebraskans (95 percent), and many are recruited from other programs on the campus as well as through visits to area high schools and industries.

Approximately 50 percent of the students in Agriculture Technology receive some financial aid. College Work-Study, Basic Educational Opportunity Grants, Scholarships, and loans are specific sources of funds. As part of the Occupational Problems course, students are encouraged to work in agri-business firms and industries. In pesticides, for example, students may be placed with a seed company or weed district for three-six months of work.

PROGRAM PROJECTIONS

The Agriculture Technology curriculum at CTCC is closely linked with USDA, EPA, and EDA interpretations of legislation. With new training mandates in pesticide use, the future for the program looks bright. The job market is unlimited for people with the skills and knowledge provided by a degree from this program according to the Ag Tech faculty.

COURSE DESCRIPTION

Ag Chemicals:

627.09 Orientation - Terminology and vocabulary used in the ag-chemical industry. (3 q.h.)

627.10 Identification - A detailed study of the identifying characteristics of weeds, insects, and diseases of plants of this area. (3-4 q.h.)

627.11 Selection of Pesticides and Herbicides - Use of technical reference materials in making correct selection of chemicals to treat specific problems. (3 q.h.)

627.12 Application of Chemicals - A study of the various types of equipment available for application of chemicals. Calibration of spray, equipment, mixing of chemicals as prescribed by manufacturer, and application procedures. (3 q.h.)

627.21 Occupational Problems - A course designed to fill individual needs related to work in agri-business. Research projects and special studies are individually planned. (2-3 q.h.)

627.23 Pesticide Applicator - This course is designed for those individuals who are going to need certification for handling restricted pesticides as will be prescribed under Federal law. (9 q.h.)

INSTITUTION: DELGADO COLLEGE

PROGRAM: Urban Pests Management

DEPARTMENT: Environmental Health

DEGREE: Certificate, Urban Pests Management
Associate of Science (A.S.) in Environmental Health Technology

CONTACT: Dr. Sushil K. Gilotra
Chairman, Environmental Science
Delgado College
New Orleans, Louisiana 70119
(504) 486-7393 x 305

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The urban pests management program at Delgado College is a new curriculum, organized in 1976, offered through the Department of Environmental Science. It is a unique and innovative program, and is available almost exclusively at Delgado. The program has received wide national recognition as a forward-looking approach to the protection of human health and the environment in the urban setting.

Students completing this program are qualified to accept positions in industrial, structural, institutional, right-of-way, and public health pesticide control and related fields. The pest management program is, therefore, a multi-faceted approach to training community personnel so that they may assist themselves in creating and/or maintaining urban environments free of pests. This program is conducted at two levels. The one-year program leads to a certificate, and the two-year program leads to an Associate of Science degree.

PROGRAM REQUIREMENTS

The certificate level program requires two semesters of course work and three semester hours of EHT 150 which is the environmental health practicum or internship training. This activity is normally completed during the summer after completion of the second semester.

Requirements for completion of the one-year certificate program in urban pests management includes the successful completion of five courses (16 semester hours) of English, math, psychology, industrial safety and related courses or equipments, tools and materials. In addition, the following environmental health technology courses must be completed:

	Course	Semester Hours
EHT 153	Recognition, Biology and Control of Pests	3
EHT 155	Pesticides & Spray Equipment	3
EHT 101	Environmental Health	3
EHT 251	Mosquito Management	3
EHT 252	Vector & Rodent Management	3
EHT 254	Biology & Control of Pests	3
Total semester hours		18

The associate degree program involves the successful completion of a two-year program of course study. Included in the requirements are 24 semester hours of English, algebra, psychology, business and related courses; six semester hours of horticulture; eight semester hours of social science and environmental health electives; and, four semester hours of chemistry. In addition, the following environmental health technology courses must be completed successfully:

	Course	Semester Hours
EH 101	Environmental Health	3
EH 107	Epidemiology	3
EH 151	Mosquito Management	3
EH 152	Vector & Rodent Management	3
EH 153/ EH 154	Biology & Control of Pests	6
EH 155	Pesticides and Spray Equipment	3
EH 156	Urban Pests and Health	3
EH 157	Seminars in Urban Pests	1
Total semester hours		25

At the end of the first year, and again at the second year the students must complete six semester hours of summer environmental health practicum courses. Students completing the associate degree are prepared to enter the world of work or to continue their studies through the baccalaureate level.

CURRENT FACULTY, STUDENTS, GRADUATES

At present, the faculty includes three full-time teaching personnel. In addition, there are 10 part-time teaching faculty members who assist in the efforts devoted to the urban pest management program.

Enrollment includes 22 full-time students. Of the total 22 students, 14 are male and seven are female. Part-time enrollment figures are not currently available. There are no firm figures, at present, on those students involved in the certificate level program.

Graduates of this program have averaged approximately two annually. For the most part, these students seek employment upon completion of their studies at Delgado.

PROGRAM PROJECTIONS

This program is quite new, but it has already received national recognition as an innovative and unique program. All indications are in the direction of program expansion and growth. One new faculty member is proposed for addition to the urban pest management staff. This is proposed to occur in three to five years.

COURSE DESCRIPTION (selected)

EHT 130 Urban Environment - Important facets of environmental health and how to improve life quality in urban areas. (1 s.h.)

EHT 140 Garden and Nursery Pests Management - Structure, recognition, biology, and control of common garden and nursery pests. (3 s.h.)

EHT 155 Pesticides and Spray Equipment - Chemicals and non-chemical agents to management pests; various spray equipment. (2 s.h.)

EHT 251 Mosquito Management - Mosquitoes, their recognition, biology, public health, and economic importance. Control methods are covered, with emphasis on non-chemical methods. (2 s.h.)

EHT 252 Vector and Rodent Management Practices - Rodents and vectors other than mosquitoes. (2 s.h.)

EHT 253 Environmental Entomology - Environment, natural balances, factors affecting the world of insects, and entomological factors affecting the world of man. (3 s.h.)

EHT 254 Recognition Biology and Control of Pests II - Basic morphology of pests and pest damage. (2 s.h.)

EHT 256 Impact of Urban Pests on Health - Diseases transmitted by mosquitoes and other pests. Life cycles of disease agents and their control. (2 s.h.)

EHT 257 Seminars in Urban Pest Management - Current topics in urban pest management. (1 s.h.)

EHT 259 Fumigation of Insect Pests - Principles of fumigation and application in control of insect pests, particularly those above the soil. (2 s.h.)

EHT 262 Marketing of Pest Management Services - Specific ways of marketing pest management services. For pest management salespersonnel, supervisors, and managers. (1 s.h.)

INSTITUTION: NEW MEXICO STATE UNIVERSITY

PROGRAM: Pest Management

DEPARTMENT: Entomology and Plant Pathology

DEGREE: Bachelor of Science (B.S.) in Agriculture

CONTACT:
Dr. Ellis Huddleston
Department Head
Entomology and Plant Pathology
New Mexico State University
P.O. Box 3K
Las Cruces, New Mexico 88003
(505) 646-3225

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Organized in 1975, the pest management degree program is a new and developing facet of the department of entomology and plant pathology at New Mexico State University. The program emphasizes the biophysical and agricultural sciences, and is designed to prepare students for careers within the field or for entrance into graduate study.

Graduates of the pest management program gain employment in occupations such as: insect and rodent control specialist; agricultural inspection technician; aerial applicator; pest management foreman; and public health sanitarian/inspector.

New Mexico State University is involved in many areas of research, which intersect with all of the environmental control areas. Federal, state and local funds contribute to the support of the various research units such as the Energy Research and Development Institute, the Environmental Institute and the Water Resources Research Institute. The New Mexico State Department of Agriculture is also located on the NMSU campus at Las Cruces. A wide variety of research and demonstration projects are conducted through the auspices of, or in conjunction with, the Department of Agriculture.

New Mexico State University is a land-grant institution which has developed a reputation of excellence in several areas including agriculture.

PROGRAM REQUIREMENTS

Admission to New Mexico State University is accomplished in accordance with the policies and conditions of the institution and the Regents. Normally, students are admitted as either regular students or non-degree students.

Completion of the baccalaureate degree, with a major in pest management, is accomplished by fulfillment of requirements which include a minimum of 128 semester credits, at least 40 of which are in upper-division courses numbered 300 or above. The departmental requirements include: BE 100, 301, 319, 314, 402 and 447; Biol 110, 220, 222, and 301; AGE 236, 252, 312, and 470; ANSC 305; HORT 311; CHEM 211; MATH 105 and 106; PHYS 110; and BA 317. In addition, at least 23 semester hours of electives are required which include: six credits in introductory plant and animal science; nine credits in agricultural and/or biological sciences; and sufficient other credits to complete the 128 minimum total.

There is no required minor. With judicious selection of electives, however, students may complete the requirements within two areas of concentration. In this event, mention would be made on the transcript of the accomplishment of a double major.

At present, there is no required internship program or applied study term. Currently, however, there are four students involved in summer internships with the U.S. Department of Agriculture. Most pest management students obtain summer employment with local companies. The faculty assists with this placement wherever possible.

The national concern regarding graduates lack of communication skills and financial management, are addressed at NMSU through courses in technical writing and business law. The department encourages students to make up deficiencies in these areas.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty for the pest management program is composed of four entomologists, two plant pathologists, one plant physiologist, and one biochemist. These persons are all full-time, cost-centered faculty members holding the degree of Doctor of Philosophy. Approximately 83% of their time is allocated to research and 17% to teaching activities.

To complement the full-time faculty, there are four part-time, non-cost-centered persons which include: one entomologist (M.S.) and three plant pathologists (Ph.D.s).

The student enrollment, at present, consists of 20 male and seven female students for a total of 27. This figure may be compared with the College of Agriculture enrollment which totals 1,400, and the overall university student population which numbers approximately 11,000.

Sources of student financial support include the federal cooperative work program. Students participating in this plan go to school for six months and work for six months. The University also employs some students as research aides and work-study participants. There are two scholarships currently available in the amount of $200 - $250 per year.

As this is a new program, there have been very few graduates as yet. The annually average number of students awarded the B.S. in this program has averaged three or four.

The majority of the graduates choose a career path upon completion of the baccalaureate work. Approximately 30%, however, pursue advanced degrees at institutions such as: Texas A & M; University of California at Riverside and at Davis; and Louisiana State University.

PROGRAM PROJECTIONS

Long range goals and objectives of the pest management program include plans for expansion. Many baccalaureate programs in pest management are considered terminal degrees. The NMSU students, however, are demonstrating increasing interest in continued education. To meet this need, the department and the university have planned the institution of a Master of Science degree program in pest management. The proposed date for operationalizing this plan is September 1979.

Pursuant to this plan of expanded degree offerings, the department anticipates additional faculty members within the next two years. These persons would include one Ph.D. range entomologist and six post-doctoral researchers. The majority of their time will be allocated to research related activities.

The department is also anticipating a curriculum revision plan which would up-grade the BE 100 Introduction to Pest Management course. This freshman level course would then be utilized for training of applicators in need of certification and/or recertification training. At the same time, this course would serve to expand the academic background of the applicator as well as to increase appropriate applied skills.

COURSE DESCRIPTION

AG E 236 Agribusiness Management Principles - Description and application of management and economic principles, functions, and techniques of management in simulated real-world agribusiness situations, such as decision making, planning, organizaing, sales forecasting, and financing. (3 s.h.)

AGRO 311 Weeds and Weed Control I - Distribution, identification, and methods of control of the common weeds of the United States. Prerequisite: Consent of instructor. (3 s.h.)

AGRO 312 Soil Management and Fertility(s) - Management, conservation, and fertility of soils associated with cultural practices and physical conditions affecting growth, nutrition, and plant production. Manufacture and properties of fertilizer materials. (4 s.h.)

AGRO 470 Environmental Pollution - Magnitude, importance, source, persistence, and control of air, soil, and water pollution. (3 s.h.)

AGRO 305 Principles of Genetics - Fundamental principles of reproduction, variation, and heredity in plants and animals. (3 s.h.)

BIOL 100 Seminar - To be taken in conjunction with another undergraduate biology course. Student will do extra reading and reporting as assigned. May be taken twice but will not satisfy science requirements in the College of Arts and Sciences. (3 s.h.)

BIOL 110 Principles of Biology - Metabolism, genetics, evolution and ecology. (4 s.h.)

BIOL 220 Botany - Structure, function, and survey of plants. (3 s.h.)

BIOL 222 Zoology - Structure, function, and survey of animals. (3 s.h.)

BIOL 301 Principles of Ecology - A survey of ecology including the adaptations of organisms to terrestrial and aquatic environment, structure and ecosystems and natural communities, population dynamics, predator-prey and competitive interactions, and productivity and nutrient cycling in natural communities. (3 s.h.)

B E 301 Economic Entomology - The identification and life cycles of insects of economic significance, their relationship to man and agriculture, including biological interactions and controls. (4 s.h.)

B E 310 Plant Pathology - Causes and methods of prevention and treatment of diseases in plants. (4 s.h.)

B E 314 Plant Physiology(s) - (3 s.h.)

B E 402 Diagnosing Plant Disorders - Systematic diagnosis of the physiological, pathological, and entomological causes of plant disorders. (3 s.h.)

B E 447 Seminar - (1 s.h.)

CHEM 211 Organic Chemistry - A one-semester survey for students requiring a brief coverage of important classes of organic compounds. (4 s.h.)

HORT 311 Weeds and Weed Control - Same as AGRO 311. (3 s.h.)

INSTITUTION: NORTH CAROLINA STATE UNIVERSITY

PROGRAM: Pest Management (For Crop Protection)

DEPARTMENT: Interdepartmental

DEGREE: Bachelor of Science (B.S.)

CONTACT: Dr. Blanche Haning, Head of Pest Management Program
Department of Plant Pathology
School of Agriculture and Life Sciences
North Carolina State University
Raleigh, North Carolina 27611
(919) 737-2721

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This academic program is carried out jointly by the Departments of Crop Science, Entomology, Horticultural Science, and Plant Pathology. It is administered by an Advisory Committee consisting of one appointed and representative faculty member from each of the four cooperating departments and a permanent chairman who also serves as Coordinator of the interdepartmental program. This committee advises administration on the needs of students and society in the area of pest management education and serves, also, as the curriculum committee for the program.

Students in pest management for crop protection receive training in the concepts of controlling pests in an ecologically sound manner. An overriding program philosophy is that control efforts must be integrated into a total crop production management program on a systems approach basis. Curriculum flexibility allows students to become generally proficient across disciplines or to develop an area of strength with a particular class of organisms. Those who complete the program should be qualified for such positions as county extension agents, technicians in scientific research organizations, pest control specialists in agribusiness concerns, and custom pest management operators.

While research funds are not presently channeled directly into the pest management program, relevant research in this field is being carried out within the cooperating departments. The facilities of these departments are available for use by students in the pest management program.

PROGRAM REQUIREMENTS

There are no special prerequisites for entrance into this program, beyond general university and school requirements. At present, the curriculum includes twelve semester hours in languages, twenty-one in social sciences and humanities, twenty-four in physical and biological sciences, and four in physical education. Additional required courses include the fields of organic chemistry, biochemistry, ecology, soil science, plant physiology, entomology, plant pathology and crop science. Two pest management courses, "Principles of Pest Management" and "Pest Management Seminar" are taken by students in their senior year. Additionally, two new courses are being proposed as additions to the curriculum: a one semester course, "Introduction to Integrated Pest Management", to be taken by students early in their programs, and a three-hour lecture/laboratory course, "The Theory and Practice of Pesticide Application", to be taken in either the junior or senior year. The Principles course will be raised to four credit hours, with the addition of a laboratory involving appropriate field trips, mathematical sessions dealing with economic analyses of pest management decisions, simulation-modeling, and student reports on selected topics. The number of required hours, 130, will not change, although the number of advised electives may be reduced.

No assistantships or other forms of financial aid are available to students through this program. Students are encouraged to work in the pest management field part-time during the school term and full-time during the summer. Many work with the boll weevil eradication program or as pest scouts with governmental programs during the summer months.

CURRENT FACULTY, STUDENTS, GRADUATES

Six faculty members in the School of Agriculture and Life Sciences teach courses for the pest management program, one on a full-time basis. Additionally, approximately thirty-five faculty members contribute in the form of conducting research and advising students. Participating faculty are also conducting in-service training programs in pest management education for county extension agents, and will offer a special three-week academic course for them during the summer of 1978.

There are currently twenty-two students enrolled in the program, representing a substantial increase since the program's inception. The number of annual graduates has grown from one in the years 1974 and 1975 to five in 1977. Nearly one-half of the graduates have opted to continue their educations after earning the B.S. degree. Of the remaining graduates, all have found employment in the pest management field, most in the private sector. There is a strong demand for pest management specialists of this nature with chemical companies.

PROGRAM PROJECTIONS

The School of Agriculture and Life Sciences, like all other schools in the university, has a quota of students that can be accepted;

the student population cannot rise above its present level. Programs within the schools can grow if enrollments in other programs decrease. Because of the rapidly increasing enrollment in the pest management program, officials anticipate that the strong demand could cause the number of students in the program to increase to forty or fifty within three years, provided that the enrollment in other programs decreases. Faculty growth would not be required with increasing enrollment; increased use would be made of faculty within cooperating departments.

The chief program goal is to continually upgrade and improve the program as the needs may be, and to produce graduates with the skills required by prospective employers. Discussions are under way regarding developing a pest management major at the master's and doctoral levels. There is considerable student interest in this possibility and the job market appears good for persons with these levels of expertise. At present, only a minor in pest management is available at the master's level.

COURSE DESCRIPTION

SSC 200 Soil Science - Fundamentals including origin, composition, and classification of soils; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships and soil management. (4 s.h.)

CS 211 Crop Science - Fundamental morphological, physiological, and reproductive features of crop plants and the management practices for economic production. (4 s.h.)

BO (ZO) 360 Introduction to Ecology - The relationships between organisms and their environment, and the interactions among organisms. An overview of basic ecology principles and their importance to humans and the environment. (4 s.h.)

BO 421 Plant Physiology - Physiology of the green plant emphasizing plant organization, water and solute relationships, organic and inorganic nutrition, growth and development. (4 s.h.)

ENT 312 Introduction to Economic Insects - The fundamentals of insect classification, development, food habits and controls. (3 s.h.)

ENT 550 Fundamentals of Insect Control - The principles underlying modern methods for protecting food, clothing, shelter, and health from insect attack. (3 s.h.)

PP 315 Plant Diseases - The nature and symptoms of plant diseases and characteristics of plant pathogenic nematodes, viruses, bacteria, and fungi. Concepts and methods of disease control are developed, based on knowledge of major types of diseases. A one-hour laboratory session on diseases of vegetable crops, or woody ornamentals and turf, or field crops, or horticultural

PP 315 (Cont'd) - crops, is also required. (3 s.h.)

PP 500 Plant Disease Control - Disease control strategies and tactics. Consideration of control economics and practices in relation to principles and current research disease resistance, and regulatory methods. (3 s.h.)

CS 414 Weed Science - Introduction to weed science covering principles and practices of cultural, biological, and chemical control. Chemistry, properties and effects of herbicides, weed identification and principles and practices of application of herbicides and their safe use. (4 s.h.)

CS (HS) 514 Principles and Methods in Weed Science - The losses caused by the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques and field research techniques. (3 s.h.)

PM 415 Principles of Pest Management - Integrates knowledge needed for making sound pest management decisions. Includes introduction to pest management concepts, importance of pest control, rationale for integrated pest control, methods of pest management and examples of existing and potential pest management programs. Emphasis on the incorporation of practices used for control of major classes of pests into management systems which least affect non-target organisms in the environment. (Laboratory proposed for fall of 1978) (3 s.h.)

PM 490 Pest Management Seminar - Written and oral presentations of scientific information relating to current trends in theoretical and applied pest management practices. (1 s.h.)

Proposed to become effective Fall 1978:

PM 111 Introduction to Integrated Pest Management - An introductory course designed to acquaint pest management majors as well as students from other curricula with the basic principles and purposes of integrated pest management from both historical and contemporary perspectives. The relationship of pest management to such problems as environmental pollution, the energy and food-population crises, use of pesticides, land-use planning and stable crop production will be emphasized. (1 s.h.)

PM 412 Theory and Practice of Pesticide Application - Principles and design of equipment for the proper and judicious application of liquid, solid, and gaseous pesticides according to their use and mode of action. State and federal laws on application and licensing will be explained. Laboratory exercises will provide hands-on experiences involving the calibration and operation of equipment, safety precautions for the applicator, and methods of preventing environmental contamination.

PM 405 Integrated Pest Management in Theory and Practice - A three-week summer course for Agricultural Extension Agents. Includes basic theory and practice of integrated pest management for crop protection. Information and understanding necessary for making sound pest management decisions and implementing pest management programs in the field will be presented. This includes proper cropping procedures, pest identification and management methods, and use of all technology available to effect optimum and stable yields in ecologically as well as environmentally and economically acceptable ways. Visits to existing crop pest management programs will be arranged. (3 s.h.)

INSTITUTION: TEXAS A & M UNIVERSITY

PROGRAM: Pest Management

DEPARTMENT: Entomology

DEGREE: Bachelor of Science (B.S.) in Entomology

CONTACT: Dr. R.E. Frisbie
Professor, Entomology
Texas A & M University
College Station, Texas 77843
(713) 845-7026

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Programs in entomology have been an integral part of the Texas A & M University curricula since the earliest days of the institution's beginnings in 1876. The pest management option, however, has received major recognition since 1967.

With the aid of the departmental advisor, the selection of courses may be designed so that the student, upon completion of the Bachelor of Science degree, may be eligible to continue on to graduate school.

By selecting the appropriate electives, students may specialize in crop and livestock protection, urban entomology or other areas of interest. There are no formal minors, however, at Texas A & M.

At present, there is no applied study term or internship associated with the pest management program. Students are encouraged to seek part-time and/or summer employment in the pest management areas.

Student financial aid is available through the university in various forms including long and short term loans.

PROGRAM REQUIREMENTS

Admission to the pest management program is predicated upon acceptance by Texas A & M University. The program is most efficiently accomplished through early indication of a major. The program may by completed, usually in four academic years.

During the first two years. students normally complete 67 semester hours. The following conurses are included in the lower division portion of the curriculum:

Course	Semester Hours
Biol 113, 114, 123, 124 Biology	8
Chem 101, 102, 111, 112, and 227, 228, 237, 238 Chemistry	16
Agro 101, 105 Agricultural Systems	4
Math 102, 130 Mathematics	6
Ento 201, Insects in Man's Environment	3
Credits	37

In addition, the curriculum includes: 15 semester hours of English and history; and, 15 semester hours of military, air or naval science, electives and physical education.

The upper division course work includes: 19 to 20 semester hours of writing, government, speech and electives; 17 semester hours of biology, genetics and physics; and, the following specific pest management related courses:

	Course	Semester Hours
Ento 301/302	Systematic Entomology	6
Ento 305/306	Insect form, function	7
P.Phy 313	Plant Physiology	3
Pl.Pa 301	Plant Pathology	3
Agro 301	Soil Science	4
Ento 401	Insect Pest Management	3
Ento 402	Economic Entomology	3
Ento 423	Medical Entomology	3
Pest Management related credits		32

CURRENT FACULTY, STUDENTS, GRADUATES

Currently, the teaching faculty total 32 full-time persons. In addition, there are 27 part-time faculty members involved in research, for a full-time equivalent total of 13 supporting persons. All 32 are cost-centered.

At present, there are no part-time students enrolled in this program. There are 36 full-time students of which 27 are male and nine are female. The program attracts a large number of students from biology, microbiology, and wildlife science. Few adult career-change persons are attracted to this program, however.

Normally, eight to 10 students will receive the Bachelor of Science degree in entomology, pest management, annually. Historically, the graduates elect the career path upon receipt of the degree. Predominantly, these graduates enter private sector employment (70%).

PROGRAM PROJECTIONS

The pest management program has an excellent reputation both within the university and across the southwestern United States. The program personnel anticipate a future of growth and expansion.

In response to the expansion plans of this program, two Ph.D. personnel will be added to the staff. The anticipated staff increases should include expertise in the areas of biological control and general pest management. These faculty members are anticipated to join the pest management program within the next five years.

COURSE DESCRIPTION (selected)

Ento 201 Insects in Man's Environment - Relation of anatomy and physiology of insects to control methods; principal insecticides and their uses; development, habits, and economic importance of more common insects with control methods for injurious species. (3 s.h.)

Ento 301 Systematic Entomology - Systematic study of non-holometabolous orders and families of insect, their distinguishing characteristics and biology. (3 s.h.)

Ento 302 Systematic Entomology - Holometabolous orders. (3 s.h.)

Ento 305 Insect Form and Organ Functions - External and internal morphology of typical insects stressing form and function. (3 s.h.)

Ento 306 Insect Physiology - Principles of the physiology of insects, general metabolism of insects, the physiology of behavior, and the function of the organ systems. (4 s.h.)

Ento 313 Biology of Insects - Emphasis placed on orders and important familes of Hexapoda. (3 s.h.)

Ento 401 Principles of Insect Pest Management - Presentation of the most important insect orders as economic entities; techniques of integrating applied insect control measures into the existing natural control factors with minimum ecosystem disruption; biological, physical and chemical control agents; cultural-management and regulatory practices. (3 s.h.)

Ento 402 General Economic Entomology - Nature of injury, life history, habits and control of common insects. (3 s.h.)

Ento 423 Medical Entomology - Study of biology, disease transmission or causation, and control of arthropods that are parasitic on or in man. (3 s.h.)

Ento 424 Insect Ecology - Effect of environmental factors on the distribution and abundance of insects. (3 s.h.)

Ento 425 Forest Entomology - Forest entomology as it is today and may become in the future. (3 s.h.)

INSTITUTION: UNIVERSITY OF CALIFORNIA, BERKELEY

PROGRAM: Pest Management
DEPARTMENT: College of Natural Resources
DEGREE: Bachelor of Science (B.S.) in Pest Management

CONTACT: Dr. D.E. Pinnock
Director of the Pest Management Program
Room 333, Hilgard Hall
University of California, Berkeley
Berkeley, California 94720
(415) 642-6000

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Initiated in 1974, the pest management program at the University of California is designed to give students a holistic approach to the problems of pest control. Interdisciplinary training permits the student to appraise and diagnose field pest problems and to recommend courses of action that are economically and ecologically sound.

Offered jointly by the Department of Entomology and Plant Pathology, students may emphasize one of four areas. These four areas include: agricultural pest management; forest pest management; medical and veterinary pest management; and, urban and recreational pest management. The curriculum consists of a basic core of required work in the physical and biological sciences. It is through the use of electives that a student will specialize in a particular area of interest.

Properly trained pest management specialists are in short supply today. The outlook for employment is bright and graduates of the program find employment with public agencies such as the U.S. Department of Agriculture; U.S. Forest Service; National Park Service; and, state departments of agriculture and forestry. An increasing number of graduates are associated with private firms such as agricultural chemical companies; consulting firms; food processing firms; corporate farms and ranches; and, forest product firms.

PROGRAM REQUIREMENTS

There are no prerequisites to enter the program other than acceptance by the university. In order to complete the major in pest management, a student must have 30 quarter hours of humanities and social sciences; 29 quarter hours of physical science and mathematics; 66 quarter hours in biological and natural resource sciences; 31 quarter hours in the major field which are the pest management courses (methods and practices); as well as a summer field course in pest management. An additional 24 quarter hours of elective courses are allowed.

Upon graduation a student may choose to intern with an appropriate governmental agency which may last up to six months. These students are supported by the Noyes Foundation which gives students a $500 per month stipend plus expenses. Funds are available for 12 interns per year. However, all students in the program must complete a summer field course at one of the university's field stations.

CURRENT FACULTY, STUDENTS, GRADUATES

Approximately 29 faculty members contribute to the pest management program. Because the university places heavy emphasis in research, none of the faculty work full-time with the program. Translated to full-time equivalent teaching faculty, the 29 equals about four. The full-time equivalent involved in research would be about 25. All 29 contributing faculty sit on a curriculum committee and collectively decide the program requirements.

From the program's inception, there has been an increase in enrollment each year. There are currently 30 declared majors. The program is expected to stabilize at this number with about eight to 15 graduates anticipated each year.

The majority of graduates find employment with private industry. About 20% of the students enter governmental agencies and the remaining students usually continue on to graduate school.

PROGRAM PROJECTIONS

Because of the success of the program, there are plans to develop a M.S. degree program in pest management within the next three years. The program is constantly being evaluated and upgraded, and program projections involve more research in the handling and storage of commodities as well as more field courses, as additions to the integral part of the program.

COURSE DESCRIPTION

PM 20 Introduction to the Philosophy, Ecology, and Economics of Pest Management - Systems approach to pest control, including the philosophy, goals, ecological basis, strategy and tactics of integrated control. (4 q.h.)

PM 151 Weeds - Identification life history, ecology, and principles of management of weeds of economic importance in agricultural, forest, range, aquatic, urban, and industrial environments. (3 q.h.)

PM 152 Insect Pest Management - Detection and sampling for pest and beneficial species and evaluation of damage. (6 q.h.)

PM 153A Etiology, Pathology, and Symptomatology - Introduction to pathology of invertebrate animals, with emphasis on management of microbial agents. (2 q.h.)

PM 153B Vector Relationships - Biological relationships of the pathogen of plants, invertebrates, and vertebrates. (3 q.h.)

PM 154B Biological and Microbial Agents - Biological control in pest management, techniques for use of parasites, predators and microorganisms. (3 q.h.)

PM 154C Cultural and Behavioral Methods - Materials and techniques for control of pests by agronomic modification and utilization of pest behavior. (3 q.h.)

PM 155B Forest Pest Management - Forest ecosystems and the impact of man on these systems. (4 q.h.)

PM 155C Agricultural Pest Management - Decision making in pest control on representative crops and crop systems. (4 q.h.)

INSTITUTION: UNIVERSITY OF CALIFORNIA, DAVIS

PROGRAM: Environmental Toxicology

DEPARTMENT: Environmental Toxicology

DEGREE: Bachelor of Science (B.S.) in Environmental Toxicology

CONTACT: Dr. Wendell W. Kilgore
Department of Environmental Toxicology
University of California
Davis, California 95616
(916) 752-1142

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Bachelor of Science program in environmental toxicology, instituted in the fall of 1974, is offered through the College of Agricultural and Environmental Sciences. Emphasis is placed on the major toxicants which include pesticides, pollutants, industrial chemicals, and poisons produced by microbes, plants and animals. Students acquire a broad background in the physical sciences, achieve depth in the core courses, and breadth through requirements in the humanities. It is through such a broad based program that students will be able to effectively deal with the properties, fate and detection of toxicants and their effects on man and his environment.

Students have the opportunity to specialize in any one of several areas of environmental toxicology. Emphasis on the physical sciences would qualify students for positions in residue analysis, environmental monitoring and forensic toxicology. Students who place more emphasis on the biological sciences will find employment in animal toxicology, environmental health and safety and pest control. The major can also serve as preparation for graduate or professional school.

PROGRAM REQUIREMENTS

Students who meet the minimum university entrance requirements, may major in environmental toxicology. Preparatory subjects in biology, general chemistry, environmental science, mathematics and physics total between 58 and 63 quarter units of required courses. The more intensive courses, or depth subjects, include six quarter units of biochemistry, two to three quarter units of organic chemistry, 23 quarter units in environmental toxicology and 24 units of approved electives. Also structured into the program requirements are eight units of English and/or rhetoric, 12 units of social sciences and humanities, between 22 to 27 unrestricted electives. Strongly recommended are 20 units of instruction in agricultural economics, environmental studies, sociology, political science and psychology. Equal or more comprehensive courses will be accepted in place of the above mentioned requirements.

Encouraged, but not required, is an internship with a state agency, or agricultural chemical company. Students earn credits through this activity. The student may chose to intern any time during the year, and the amount of credit earned depends on the intensity of the program and the plan as arranged with the advisor. Students may also receive pay for their work, in addition to university credits.

Students in need of financial assistance may be eligible to receive general financial aid through the university.

CURRENT FACULTY, STUDENTS, GRADUATES

At present, 12 faculty members comprise the staff of the Department of Environmental Toxicology. Approximately two-thirds of each faculty member's time involves research. The remaining one-third of their time is allocated to teaching or administrative duties.

The program attracts a large number of students from the biological sciences. Because enrollment is limited, prospective majors must contact the major advisor early in the spring of their sophomore year. There are currently 42 students enrolled in the program. The program has remained stable with 20 to 24 graduates per year.

Upon graduation, about 25% of the students continue on to graduate school. The students who seek employment usually have little difficulty in finding jobs. About 75% are employed in their field of study. Approximately 50% of the students gain employment with government agencies. The other 50% are employed by private companies. Students use the placement office on campus as well as follow-up on announcements of job openings or inquiries which come into the department.

PROGRAM PROJECTIONS

The program is currently at its optimum size, and there are no significant changes expected to occur in the near future. The internship program is a valuable part of the curriculum and will probably expand. If funding is made available, more cooperative extension workshops and seminars will be held.

The university offers a graduate program in pharmacology and toxicology. Approximately 10% of the undergraduates continue their work in these graduate programs. There are 60 students at present in the advanced program, and an average of 15 Ph.D. candidates graduate per year.

COURSE DESCRIPTION

10 Introduction to Toxicology - Occurance, properties and effects of toxic substances in personal, occupational, community, and global environments. (4 q.h.)

99 Special Study for Undergraduates - (1-5 q.h.)

101 Principles of Environmental Toxicology - A unified introduction to principles underlying the use and environmental consequences of pesticides, food additives, and other chemicals, their regulations; and their health significance. (3 q.h.)

112A Toxicants in the Environment - Properties of toxic chemicals which influence their distribution and transformations; action of environmental forces which affect toxicant breakdown, movement, and accumulation. (3.q.h.)

112B Toxicants in the Environment - Toxic chemicals-primarily pollutants-in the environment; concepts and techniques of sampling, detecting and measuring toxicants of current concern, collection, interpretation, and use of analytical data. (4 q.h.)

114A Biological Effects of Toxicants - The biological effects of toxic substances in living system. (3 q.h.)

114B Biological Effects of Toxicants: Comparative Toxicology - Basic principles of toxicology and laboratory techniques for evaluating potential toxicity of chemicals. (4 q.h.)

130A-E Selected Topics in Environmental Toxicology - Topics will vary and will emphasize such areas as the microbiology of toxic substances, poisonous plants and animals, chemical ecology, toxic substances in foods, and the safe handling of toxic substances. (3 q.h.)

131 Air Pollutants - Toxicological aspects of major contaminants of the ambient air, with emphasis on their environmental fate and biological functions. Factors governing air quality criteria and standards. Alternatives in air pollution abatement. (3 q.h.)

138 Legal Aspects of Environmental Toxicology - Federal and California legislation concerning air and water pollution, pesticide use, food and feed additives, consumer protection, and occupational exposure to toxic substances; roles of Federal regulatory agencies; alternatives to governmental control. (3 q.h.)

INSTITUTION: UNIVERSITY OF DELAWARE

PROGRAM: Entomology and Applied Ecology

DEPARTMENT: Entomology and Applied Ecology

DEGREE: Bachelor of Science (B.S.)

CONTACT: Dr. D.F. Bray, Professor
Chairperson of Department of Entomology and Applied Ecology
University of Delaware
Newark, Delaware 19711
(302) 738-2526

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Two majors are offered to undergraduate students by the Department of Entomology and Applied Ecology, a major in Entomology and a joint major in Entomology/Plant Pathology, in cooperation with the Plant Science Department. The Entomology major offers options in entomology and ecology. The Entomology/Plant Pathology major offers options in applied entomology and plant pathology. The program was first started in 1945. Students are prepared for the following occupations: industry (product development, sales, management); government (teaching, research, extension), university (teaching, research, extension); pest control industry; and pest management positions.

Students do not have access to any unique facilities in this program but do receive a large quantity of field research training. Pesticide training for certificates is conducted by staff for pest control operators and pest management specialists.

PROGRAM REQUIREMENTS

In order to complete the requirements for the baccalaureate degree, a total of 139 credit hours are required by the College of Agricultural Sciences. Structured into the curriculum are one year of chemistry, two biology courses (concepts of Biology and Environmental Biology), a course in literature (Literature of the Agricultural and Life Sciences), and thirty credits in Entomology. The Entomology courses which are required of all majors include Fundamentals of Entomology, Structure of Insects, Systematic Entomology, and a Seminar. The joint major gives the student the option of taking fifteen credits in either Entomology or Plant Pathology and nine other credits with six additional being in either of the two fields. Some University financial aid is available to students in limited amounts.

CURRENT FACULTY, STUDENTS, GRADUATES

Eight faculty members currently contribute to the teaching of the Department's curriculum. All eight staff members are involved in research activities (e.g. Hatch funds) and in terms of full-time equivalents about 4.5 persons are involved in teaching, and 3.5 in research.

There are currently 70 students enrolled in the program. Most (60) are full-time (20 female, 40 male) and the balance (10), are part-time (5 female, 5 male). Ten students have been graduating annually in recent years earning the baccalaureate degree. The Department has the third largest enrollment of the five schools in the College of Agricultural Science.

According to the results of an Alumni Survey conducted by the Department in 1976, of those whom responded, 70 percent were still employed in the profession. Also, 55 percent of the program's graduates continue on for advanced degrees.

PROGRAM PROJECTIONS

The Entomology and Applied Ecology program is expected to expand with an increased emphasis on ecological principles in subsequent years. There may be a slight decline in faculty staffing in the next five years due to budgetary constraints. It is not anticipated that there will be any additional degree programs developed by the Department because the present majors have proven to be very successful so far.

COURSE DESCRIPTION*

(a partial listing of course offered)

ENT 205 Elements of Entomology - Insects: their evolution, ecology, control, and impact on history and culture. (3 s.h.)

ENT 305 Fundamentals of Entomology - A course in the general classification of insects emphasizing evolution, structural morphology, development and ecology. (3 s.h.)

ENT 411 Economic Entomology - Current problems in entomology. Habits and control of insects affecting crops, homes, and well-being of humans with emphasis on the ecological basis of insect control. (3 s.h.)

ENT 611 Economic Entomology - The habits and control of insects affecting crops, homes, and well-being of humans with emphasis on the ecological basis of insect control. (3 s.h.)

ENT 614 Insect Ecology - The study of insect population dynamics: the interaction of environmental factors that determine insect distribution and abundance and strategies of insect population management in applied ecology. (3 s.h.)

ENT 616 Ecology Laboratory - A laboratory and field course on the principles of ecology with emphasis on population dynamics. (2 s.h.)

ENT 619 Principles of Biological Control of Insects - The historical ecological, and biological basis of biological control of pests. (3 s.h.)

ENT 622 Insect Toxicology - The study of biological activity and physical and chemical properties of insecticides. (3 s.h.)

*The university utilizes a 4-1-4 (month) calendar system.

INSTITUTION: UNIVERSITY OF GEORGIA

PROGRAM: Entomology

DEPARTMENT: Entomology

DEGREE: Bachelor of Science in Agriculture (B.S.A.)
Bachelor of Arts (A.B.)

CONTACT: Dr. Preston Hunter, Head
Department of Entomology
University of Georgia
Athens, Georgia 30602
(404) 542-2816

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Entomology was organized in 1954. Students may pursue a B.S.A. or, more uncommonly, an A.B. degree through the College of Arts and Sciences. Most often students enroll in the College of Agriculture for the B.S.A. Entomology is considered excellent preparation for medical school.

During the mid-sixties, the National Science Foundation and the State of Georgia granted the Division of Biological Sciences, which includes the Department of Entomology, ten million dollars for the development of a "Center for Excellence". It was during that time that the faculty grew from five to eighteen (in Entomology), and extensive specialized instrumentation for research and instruction was acquired. Since then no substantial amount of equipment has been bought and two faculty members have retired. Presently, the departmental inventory of equipment is adequate for all of this program's purposes and students have ready access to it.

Graduates will find positions in teaching, research, control and extension entomology which exist in college and universities, experiment stations, state departments of entomology, the U.S. Department of Agriculture, the U.S. Public Health Service and in various private concerns doing pest control, or insecticide compounding or manufacturing.

PROGRAM REQUIREMENTS

Those individuals who wish entrance to the freshman class should have taken college preparatory high school subjects which include English, math, science, history, and a foreign language. Students who have taken a foreign language for two years are required to take the College Board Achievement Test in that language. The

College Entrance Examination Board's Scholastic Aptitude Test and Mathematics Achievement Test are required of all freshman applicants.

Through the College of Agriculture, the first two years consist of twenty hours in the humanities, twenty hours in mathematics and natural science, twenty hours in social science and thirty hours of major-related course work. In the case of Entomology these major-related courses are taken in the Departments of Botany, Zoology, Agronomy and/or Geography. At the end of the sophomore year a decision must be reached as to what one's major will be.

Two choices exist for concentrated study, one being the administrative option, the other the science option. While the major courses do not differ greatly between the two options, the supportive course work bears the distinction. In both cases twenty-five hours of selected entomology courses are required.

Science option students take twenty-five hours to be selected from a limited number of courses in microbiology, genetics, botany, geology, geography, plant pathology, statistics and zoology. Students are required to complete two ten-quarter-hour minors; one may be taken in the College of Agriculture. Ten hours of a foreign language are required. The remaining twenty hours are free electives.

The Administrative option requires completion of fifteen hours of agricultural economics and twenty hours in business administration. Ten hours must be chosen from statistics, economics, agricultural economics or finance. Plant Pathology 353 and Genetics 358 are both mandatory. Students have twenty hours of free electives under this curriculum.

Through the College of Arts and Sciences, the first two years' curriculum consists of five to fifteen hours of a foreign language; ten hours each of English, literature, history, social sciences, and humanities; fifteen hours of mathematics; thirty hours of science courses; and twenty hours of mathematics/science electives. At the end of the sophomore year a student must declare a major and begin work in the appropriate department.

CURRENT FACULTY, STUDENTS, GRADUATES

A total of sixteen faculty comprise the Department of Entomology. Approximately one-third of their effort is devoted to teaching, and two-thirds to research projects.

There are currently twenty-one students enrolled in the combined programs of entomology. Most of these students are transfer students from other colleges, often out of state. Students who are enrolled in Entomology through the College of Agriculture or the College of Arts and Sciences may compete for two in-state tuition P.W. Fattig school scholarships. There has been an average of around ten people graduating each year.

A recent follow-up study located all but 10 percent of the forty-two graduates from the years 1971 to 1977. Thirty percent continued their study in advanced degree programs, 45 percent found positions which were directly related to their study, 15 percent changed their fields and are working in unrelated areas. This same study indicated that 15 percent (of the 45 percent in related occupations) are working for private companies, and 30 percent are in the government's employ.

PROGRAM PROJECTIONS

It would be desirable to expand the program in the areas of chemical ecology and developmental physiology, environmental entomology, agro-ecology, and emphasizing a team approach to pest management.

Because faculty expansion was the direct result of a grant, the positions which were acquired during the mid-sixties may not be refilled as people retire; rather, the positions will return to the university, which will distribute the option to hire faculty based on university-wide need.

ADDITIONAL INFORMATION

It is interesting to note an additional distinction which is felt to exist between the undergraduate students and the graduate students regarding pest control. Commonly, the undergraduate student favors the traditional controls, i.e., pesticide use, when a particular pest happens to be in evidence. The graduate students, on the other hand, favor the overall year-round pest management programs which are anticipatory in nature.

COURSE DESCRIPTION

ENT 325 General Entomology - An introduction to the classification, biology, and habits of insects. (5 q.h.)

ENT 374 Agricultural Entomology - A brief introduction to entomology, followed by a study of the recognition and control of insect pests of crops and animals. An introductory course designed for non-entomology majors. (5 q.h.)

ENT 376 Medical Entomology - A brief introduction to entomology followed by a study of the species of insects and related arthropods of particular importance in the cause of transmission of diseases of man and the lower animals. (5 q.h.)

ENT 382 Forest Protection: Entomology - A brief introduction to entomology followed by a study of the insect pests of American forests. (5 q.h.)

ENT 384 Urban and Industrial Entomology - A study of the recognition, biology and control of insect pests and other arthropod forms which infest areas inhabited by man. (5 q.h.)

ENT 440 Insect Behavior - An evolutionary approach to the principles of behavior with emphasis on reproduction, mimicry, insect-plant interactions and the development of sociality. (5 q.h.)

ENT 470 Insect Histology - Comparisons of the histology and anatomy of insects, other invertebrates and vertebrates are made. Insect tissues are dissected and preparation of the major body systems are examined for gross and microscopic differences. (5 q.h.)

ENT 474 Advanced Agricultural Entomology - A study of major methods of insect control emphasizing practical integration of suppression techniques for an optimum pest management system. (5 q.h.)

ENT 477 Chemistry and Toxicology of Insecticides and Fungicides - A study of the biology, use and impact of insecticides and pesticides in agriculture and their chemistry in the environment. (5 q.h.)

ENT 480 Introductory Acarology - An introductory study of the structure, classification, and biology of mites. (5 q.h.)

ENT 494 Aquatic Entomology - An introduction to taxonomy, life history and ecology of aquatic insects. (5 q.h.)

INSTITUTION: UNIVERSITY OF NEW HAMPSHIRE

PROGRAM: Entomology

DEPARTMENT: Entomology

DEGREE: Bachelor of Science (B.S.), Bachelor of Arts (B.A., Entomology)

CONTACT: Dr. James S. Bowen, Extension Entomologist
Department of Entomology
University of New Hampshire
Durham, New Hampshire 03824
(603) 862-1707

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Entomology Department, within the College of Life Sciences and Agriculture, offers a fundamental training in entomology and related fields for students who wish to study insect control, insect life, and insects in their relation to man. Graduate study is available for students planning a professional career in entomology. Graduate students may specialize in chemical control of insects, for example, and thereby would be expected to take courses in mathematics and chemistry.

Graduates often find employment with federal and state agencies (State Department of Agriculture), in public institutions, and with commerical and industrial firms. Within industry, jobs exist in providing technical services, research sales, commercial pest control, and mosquito control. Opportunities also exist in crop protection, conservation forestry, and in public health. Teaching and research positions are also available for studying taxomony and basic entomology.

The Department utilizes facilities run by the University's Agricultural Experiment Station for Research. A reference museum maintained by the Entomology Department contains over 300,000 insect specimens to assist students in taxomony and classification of insects and identifying pest problems. An effort has been undertaken by Department staff to assist students in finding summer employment in this field although the employment effort is not part of the required curriculum. Summer positions are often available in the pest control industry, working in fields, and mosquito abatement districts. For example, these paraprofessionals often assist county extension officers in answering homeowner problems.

A variety of financial aid is available to students to help them defray their educational expenses. Industrial grants, work-study, hourly teaching funds and experiment station money are several forms of assistance available to the Department's students. Benginning in February, 1978 the Entomology Department received two Graduate Research Fellowships in Applied Entomology.

PROGRAM REQUIREMENTS

No special requirements are set by the Department to admit students into the undergraduate program other than what is specified by the College of Life Sciences and Agriculture. It is recommended that a student have solid mathematics and science background prior to applying to this program.

The Entomology Department requires the successful completion of 32 semester credits of courses offered by the Department. With the consent of the major advisor, courses offered by other departments may also be counted toward completion of the degree.

CURRENT FACULTY, STUDENTS, GRADUATES

Six faculty members teach the Department's entomology curriculum and four persons conduct research. None of the faculty members are full-time instructors and all except one conduct research and two are involved with extension activities.

The Entomology Department has a total current enrollment of 35 students including one part-time. It is common for students from other academic areas to make career changes in their programs by entering the entomology program from other areas. Many from the Environmental Conservation Program conduct joint major or finish their curriculum within the Entomology Department guidelines. Enrollment is five students per year and appears to be increasing.

Many of the Department's students have continued on for the advanced degree offered by the program. The Entomology Department has accepted Entomology students from Cook College at Rutgers for example. Others have continued on to Ohio State University, the University of Maryland, the University of Wyoming, the University of Illinois, and the Virginia Polytechnic Institute and State University, for their advanced degrees in entomology.

Although the University operates a placement service to assist students in their employment search, a greater degree of success has been found through the Department's faculty contacts with industry representatives. Jobs are available within both the private and governmental sectors and several have been successful in establishing their own pest control businesses.

PROGRAM PROJECTIONS

The Entomology Department anticipates hiring two additional staff members within the next two years. Both will probably be extension personnel and the hiring will necessitate acquiring one additional staff support person. The program is expected to change to a greater emphasis concerning the application of entomology to pest control and management. Additional integrated Pest Management courses may be added to the present curriculum.

A new degree program in pest management may be offered at the undergraduate level and it will probably be interdisciplinary and not necessarily offered by the Entomology Department. It is anticipated that the Plant Pathology and the Plant Science Departments would probably cooperate in offering such a new program. The Department has undertaken to shift to offering a curriculum in more of an applied science nature in order to aid the commercial pest control industries in the New England region.

COURSE DESCRIPTION (partial listing only)

400 Insects: Their Role As Man's Greatest Competitor - Insects and their relations to man, his environment, and his activities. (3 s.h.)

402 Introductory Entomology - The structure, biology, and classification of insects. (4 s.h.)

503 Principles of Economic Entomology - The nature of insect damage and the methods of insect control. (4 s.h.)

524 Public Health Toxicology - Problems in evaluation of toxicoloical risks are considered. Emphasis is placed on large human populations exposed to low levels of toxic chemicals. (4 s.h.)

526 Ecology and Environmental Toxicity - Poisons in the environment are studies in terms of actions on living populations, ecological consequences, and social costs and benefits. (4 s.h.)

533 Behavioral Pharmacology and Toxicology - The two aims are to survey the principal techniques used to ask questions about the effects of chemical substances on behavior, and to examine current research findings. (4 s.h.)

535 Aerosols - This course emphasizes the importance of a general quantitative understanding of the physical properties and behavior of fine particles and of the principles underlying the generation, dispersion, measurement, suppression, and control of fine and coarse aerosols. (4 s.h.)

570 Neurotoxicology of Environmental Contaminants - This seminar examines the action of a variety of substances on the central nervous systems and on behavior, emphasizing the correlations between the neurochemical morphological effects and the impairment of behavior. (4 s.h.)

704 Medical Entomology - Insects and arachnids in relation to public health; the biology and control of important disease carriers. (4 s.h.)

720 Agricultural Entomology - A survey of economic insect pests on forage, fruit, and vegetable crops. Life cycles; damage and current methods of control. (4 s.h.)

721 Principles of Biological Control - The natural and applied aspects of biological control of insect and plant pests. (4 s.h.)

722 Chemical Control of Insects - A systematic review of the chemical compounds for insect control with studies insect toxicology.

723 Regulatory Pest Control - The study of legal documents, federal and state statutes regarding the movement of agricultural commodities in internal and foreign trade. (4 s.h.)

724 Structural Pest Control - For students wishing to study household and industrial entomology. (4 s.h.)

INSTITUTION: OREGON STATE UNIVERSITY

PROGRAM: Pest Management and Plant Pathology

DEPARTMENT: Botany, Plant Pathology and Entomology

DEGREE: Bachelor of Science (B.S.), Master of Science (M.S.) in Botany and Plant Pathology

CONTACT: Dr. Thomas Carrol Moore
Chairman, Plant Pathology and Botany
Oregon State University
Corvallis, Oregon 97331
(503) 754-1133

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The undergraduate programs in botany and plant pathology have been offered by Oregon State University since 1969. By 1972, the specialized pest management curriculum had been developed. Today, pest management is a program which is conducted cooperatively by the Departments of Botany, Plant Pathology and Entomology. These departments represent the College of Science and the College of Agriculture, and, therefore, are able to offer a wide variety of courses and research opportunities to both students and faculty.

The graduate level program was instituted in 1963. While the graduate program is not entitled pest management, students are able to prepare graduate level group experiences and course work which emphasize this area of increasing concern.

The undergraduate program in pest management leads to the Bachelor of Science degree, while the graduate program leads to the Master of Science and the Doctor of Philosophy degrees. For the purpose of this narrative, however, the B.S. and M.S. degrees are described in the following text.

Oregon State University is well endowed with museums and collections which serve to support the academic endeavors of the students interested in the field of pesticide control and usage, as well as the community at large. The Natural History Museum, the Archive for the History of Science and Technology, and the Entomological Collection are representative of these types of supporting educational resources. The Agricultural Experiment Station is an integral part of the OSU research and instructional facilities. Faculty from the various department not only teach, but conduct research and agricultural experiments which serve to enhance several of the related fields of environmental concern.

The International Plant Protection Center was established at OSU in 1969 in order to develop and to administer innovative and effective programs of plant protection in the developing countries. The Center works in close cooperation with the federal government, the state and the United Nations.

The availability of ennumerable resources and well qualified faculty have served to enhance the OSU reputation of excellence in the areas of pesticides development, usage and control.

Financial assistance is available to both undergraduate and graduate students, in various forms. Long and short-term loans, assistantships, scholarships and fellowships are among the availabilities.

PROGRAM REQUIREMENTS

Admission to the Oregon State University programs in pest management and plant pathology, botany and entomology, is accomplished by means of acceptance by the university. The graduate student must, in addition, seek entrance to these programs through the Graduate School.

In response to the needs for well-equipped graduates with a broad-based and balanced education, OSU requires not more than 60% of the course work in areas of science and no more than 40% of the work is required in a single area, at the baccalaureate level.

In general, the first two years of the undergraduate pest management program are quite similar to those of the general botany and plant pathology. In addition, the pest management student will complete, however, two pest management seminars (Bot 199) for two quarter hours of credit, and three to five quarter hours of general horticulture or crop production.

Requirements for third and fourth years involve successful completion of the following in order to be eligible for the baccalaureate degree in pest management.

Course	Quarter Hours
Third year:	
General Physics (Ph 201, 202)	8
Approved course in communication skills	3
General Ecology (Bi 370)	3
Plant Pathology (Bot 450)	5
Plant Physiology (Bot 331)	5
Applied Entomology (Ent 311)	4
Weed Control (ACS 418)	5
Soils (Sls 210)	5
Genetics (Bi 341)	4
Systematic Botany (Bot 321)	4
	46

Course	Quarter Hours
Fourth year:	
Nematode Diseases of Plants (Bot 554)	4
Plant Protection Entomology (Ent 442)	3
Principles of Insecticide Usage (Ent 441)	3
Plant Breeding (ACS 415)	3
Field Plot Technique (ACS 516)	5
Extension Methods (EM 411)	3
Statistical Methods (St 451)	4
Plant Anatomy (Bot 471)	4
Economics (sequences including general, agricultural, and forest economics)	9
Pest management seminar (Bot 401 - Research)	1
Electives	8
	47

The Master of Science candidate must successfully complete a program of study totaling not less than 45 term (or quarter) hours which includes a thesis and courses approved for graduate credit. Approximately 30 hours or two-thirds of the work must be in the major, and approximately 15 hours or one-third of the work must be in the minor. An oral final examination is required of every master's degree candidate. Under certain conditions, and with the approval of the appropriate faculty members, a thesis may be optional.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty involved in these programs at both the baccalaureate and the master's level consists of eight full-time teaching members. In addition, there are 30 persons involved in research related activities. Of these additional 30, one is full-time and the remaining 29 equate to 16 full-time-equivalent. It is quite difficult to assign cost-centered personnel as the programs are interdepartmental as well as multidisciplinary in nature.

Enrollment figures do not include possible part-time students. At the baccalaureate level, there are presently 30 full-time students. Approximately 66% or 20 students are male, while approximately 33% or 10 students are female.

At the graduate level, there are approximately 28 male students (78%) and approximately eight female students (22%) for a total of 36 full-time students. Adult career-change students are attracted to this program. Approximately 18% of the graduate students from these disciplines are involved in pest-management related studies.

Graduates receiving the baccalaureate degree average approximately 30 annually. At the graduate level, approximately 12 students per annum are awarded the master's degree.

On the average, approximately 50% of those students receiving the Bachelor of Science degree, elect to pursue advanced studies. The school usually receiving these graduate students, include the University of California at Davis, University of Illinois at Urbana, Purdue University and the University of Wisconsin.

At both levels, students choosing the career path are employed predominantly (90%) in their field or in a related field. Approximately 35% enter private sector employment while the remainder enter the public sector, consulting and/or (at the advanced levels) teaching in post-secondary institutions.

PROGRAM PROJECTIONS

The faculty and administration concerned with these programs are hesitant to describe future increases or decreases. Rather, the program will expand pursuant to the demand for such growth.

There is some discussion, at present, regarding an increased quantitative emphasis within course offerings. Another future plan addresses the possible organization of a doctoral program in international agriculture. No time-lines have been established regarding the new degree option, however.

COURSE DESCRIPTION (selected)

Undergraduate courses:

Bot 199 Special Studies - An unstructured lower-division course for independent study in various fields of botany. (Terms and hours to be arranged)

Bot 201, 202, 203 General Botany - Phylogenetic survey of the plant kingdom, morphology. (4,4,3 q.h.)

Bot 316 Aquatic Plants - Ecology, taxonomy, and economic significance. (4 q.h.)

Bot 320 Fungus Deterioration of Wood Products - Relation of decay in standing timber to decay of wood products; fungus deterioration. (3 q.h.)

Bot 321 Systematic Botany - Vascular plants. Plant classification; collection and identification. (4 q.h.)

Bot 331 Plant Physiology - Physiological processes stressing modern concepts and areas of research. (5 q.h.)

Bot 341 Plant Ecology - Structure, methods of analysis, environmental relations, and dynamics of vegetation. (4 q.h.)

Bot 350 Introductory Plant Pathology - Symptoms, causal agents, diagnosi and prevention of plant diseases. (4 q.h.)

Undergraduate and/or Graduate courses:

Bot 411, 421 Morphology of Nonvascular Plants - Structure, reproduction, and phylogeny of the algae. (5 q.h. each)

Bot 413 Morphology of Vascular Plants - Structure, reproduction, and evolutionary history of vascular plants. (4 q.h.)

Bot 414 Agrostology - Classification and identification of grasses. (4 q.h.)

Bot 415 Forest Pathology - Disease in relation to forest development, protection, and harvest. (3 q.h.)

Bot 421 Advanced Systematic Botany - Evolutionary approach. (5 q.h.)

Bot 425 Plant Taxonomy - Use of taxonomic keys; floral structure, relationships and diagnostic characteristics. (3 q.h.)

Bot 431 Bioenergetics of Plants - The function of membranes and various plant organelles. (3 q.h.)

Bot 432 Photobiology of Plants - Detailed physiological and biochemical coverage of the photobiology of plants. (3 q.h.)

Bot 433 Hormonal Regulation of Plant Growth and Development - Roles of hormones, inhibitors, and phytochrome in the regulation of growth and development. (3 q.h.)

Bot 441, 442, 443 Advanced Plant Ecology - Environmental factors affecting plant growth. (3 q.h. each)

Bot 450 Plant Pathology - Infectious and non-infectious plant diseases. Nature of pathogens and pathogenesis. (5 q.h.)

Bot 451 Plant Disease Diagnosis - Field trips and laboratory on plant disease identification and control. (3 q.h.)

Bot 453 Epidemiology and Disease Control - Quantitative epidemiological analysis of plant diseases and relationship to disease control. (5 q.h.)

Bot 462 Mycology - Classification of fungi; techniques of collection and preservation; literature of mycological taxonomy. (5 q.h.)

Graduate courses:

Bot 535 Physiology of Plant Differentiation and Morphogensis - The physiology and biochemistry of differentiating plant systems in the algae, bryophytes, and higher plants. (3 q.h.)

Bot 541 Plant Geography - Origin, development, and distribution of major units of vegetation, with emphasis on western United States. (3 q.h.)

Bot 551 Plant Virology - Nature and properties; symptomology; transmission, inhibitors; purification; electron microscopy; serology; control. (3 q.h.)

Bot 552 Bacterial Diseases of Plants - Biology and identification of causal agents. (5 q.h.)

Bot 554 Nematode Diseases of Plants - Nematology, identification and biology of nematodes. (4 q.h.)

Bot 560 Fungicides - Chemical control of plant diseases. (3 q.h.)

Bot 564 Physiology of Fungi - Fungus growth, reproduction, survival. (5 q.h.)

Bot 566 Physiology of Parasitism - Recent advances in specific fields in plant diseases. (4 q.h.)

Bot 573 Plant Cytogenetics - Effects of variations in chromosome structure and number. (4 q.h.)

Supporting courses:

G 543 Palynology - (4 q.h.)

Sls 522 Plant-Water Relations - (3 q.h.)

Z 454 Principles of Symbiosis - (4 q.h.)

INSTITUTION: THE PENNSYLVANIA STATE UNIVERSITY

PROGRAM: Entomology

DEPARTMENT: Entomology

DEGREE: Bachelor of Science (B.S.); Master of Agriculture degree in Entomology; Master of Science degree in Entomology; Doctor of Philosophy (Ph.D.)

CONTACT: Dr. Beckford F. Coon
Head of the Entomology Department
106 Patterson Building
The Pennsylvania State University
University Park, Pennsylvania 16802
(814) 865-1895

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Entomology Program was started in 1875 but the pest management portion was first initiated in 1972 at Penn State University. The Department of Entomology's instructional program offers courses for students majoring in a wide range of agricultural, biological and environmental fields. The program also provides specialized preparation for careers in entomology at the baccalaureate, master's and doctor's levels. Employment opportunities exist with federal, state, and local governmental agencies, in agribusiness, and in the pest control industries. Students with graduate training find careers in research, extension, teaching, or private enterprise.

Entomology majors may specialize in: economic entomology, forest entomology; apiculture; insect resistance in plants; arachnology; medical or veterinary entomology; biological control; insect pathology; insect transmission of plant pathogens, ecology; morphology embryology; taxonomy; insect behavior; or chemistry of pesticides.

The Department of Entomology has a variety of facilities available to assist students in their studies and research. Included are the Frost Entomological Museum, research facilities, a reading room, Insectary, Research Unit C, and Pesticide Research Laboratory and Rock Springs. The Rock Springs Agricultural Research Center and the Fruit Research Laboratories maintain field research plots. Extensive library resources are located in the Life Sciences Library, a part of the Main University Library. The Department's basic and applied research centers on the major insect problems of the Commonwealth of Pennsylvania.

PROGRAM REQUIREMENTS

Undergraduates enroll in the College of Agriculture and the Department of Entomology. The College's entrance requirements are followed and include a science or college preparatory curriculum. Prospective applicants should take courses in biology, chemistry, and mathematics in high school to prepare for this program. Admission to the advanced degree programs requires that applicants have a baccalaureate degree from an accredited institution and a grade point average of 3.0 (B) for the last two undergraduate years. Required are a minimum of 24 credits of entomology and biological sciences and chemistry through organic, physics, mathematics through calculus, and statistics. A limited deficiency may be made up without graduate credit.

The Master of Agriculture degree in Entomology is a professional degree leading to the development of special skills in practical areas such as pest control and pesticide recommendation and application. A minimum of 30 graduate credits (400 and 500 level courses) are required of which 20 must be earned in residence (12 credits must be in Entomology). A maximum of 10 credits may be earned in Special Problems or Special Topics. A three credit paper on a selected problem or a report on internship training must be presented. One seminar credit is required and a departmental oral examination must be passed. The degree requirements must also be completed within three calendar years. The M.Agr. program is particularly suited for training chemical sales personnel, pest management specialists, managers of pest control establishments and various government staff positions.

The Master of Science degree in Entomology is an intermediate or a terminal degree which leads toward special proficiencies development and training for prospective doctoral candidates. Requirements include a minimum of 30 graduate credits of which 20 must be earned on the University Park Campus. Eighteen credits must be taken in graduate courses or research (500 and 600 levels). Six credits (600 level) of an acceptable thesis must be submitted, and all students take the three core courses and earn two seminar credits.

The degree of Doctor of Philosophy does not entail any formal credit requirement, but normally requires three years of graduate work. Three terms in residence within a 12 month period is required. A thesis is required as is an effective reading knowledge of one foreign language. A comprehensive examination is administered by the doctoral committee after the course work is essentially complete, and language requirements are satisfied. On completion of the thesis, the candidate presents the work in a seminar and defends the thesis orally befoer the doctoral committee. Doctoral candidates are required to take the three core courses (Ent.414,415,416)

10 additional credits in organized graduate courses in the department, 2 credits in departmental seminars, 3 credits in statistics, and two courses outside the department.

The undergraduate major is required to complete 128 credits to earn the baccalaureate degree. This includes 75 credits of baccalaureate degree requirements, 33 credits of major requirements, and 20 credits of electives. An additional 30 credits are required for the Master degrees.

Financial aid available to students include university fellowships and assistantships. Currently there is one departmental fellowship and eight assistantships offered by the Entomology Department.

CURRENT FACULTY, STUDENTS, GRADUATES

Thirteen faculty members (one full-time) teach the program's curriculum. Nineteen faculty staff are currently involved in research activities. The department also has four adjunct faculty and five extension faculty members. Research is currently funded by the National Institutes of Health the National Science Foundation, industry and the U.S. Department of Agriculture. Industry sources include agricultural-chemical companies and pharmaceutical companies such as DOW, Dupont and American Cyanide. The Agricultural Research Service, the Forest Service, and the Animal Plant Health Inspection Service are the U.S. Department of Agriculture funding sources.

There are currently (Spring, 1978) fifteen full-time (four female) undergraduate students enrolled in the program. Thirty-five students are enrolled in advanced degree programs (4 female, 0 part-time). It is estimated that of the 35 advanced degree students, 70 percent are in the M.S. program (24), two percent in the M.Agr. program (1), and 28 percent are in the doctoral program (10).

The B.S. program has only produced two graduates so far as it is still relatively new. Approximately 4 to 5 students receive advanced degrees on an annual basis. Enrollment in the College of Agriculture has dramatically increased 185 percent since 1972 and only recently have students been electing entomology majors in greater numbers.

Many undergraduates continue on for advanced degrees at various other land-grant institutions. Most master's students continue on for doctorates at Penn State. Virtually all graduates have found employment in the field as the Department has a good job placement record. Approximately 20 percent of the program's graduates find industry positions and 80 percent find jobs in the government (federal-state university or government research).

PROGRAM PROJECTIONS

The Entomology Department has experienced an increasing enrollment in entomology-pest management. This enrollment increase is reflected in the fact that the subject is of increasing importance to any discipline using agricultural chemicals. There is a need to increase the research effort in pest control in the department as research money is being cut and research has lagged.

Two extension entomologists and two additional faculty members are expected to be recruited when budget conditions permit. Additional teaching and research needs at present are in the areas of vegetable insect control research and insect residues in plants. Because of the Department's budget problems with the State, there are no hiring plans as the program is attempting to maintain its present staffing level.

COURSE DESCRIPTION

(the following is a partial listing of courses)

ENT 2 General Entomology - Biology, taxonomy and management of insects and related arthropods. (3 s.h.)

ENT 21 Economic Entomology - Entomology emphasizing insects of economic importance in plant porduction and their control. (3 s.h.)

ENT 416 Methods for Insect Pest Population Management - A principle approach emphasizing characteristics, application, efficacy and integration of management systems. (3 s.h.)

ENT 418 Forest Entomology - The bionomics, detection, evaluation, and systems of control of forest insects. (3 s.h.)

ENT 518 Pest Management - Current concepts and controversies in modern agricultural and urban pest management practice. (1 - 3 s.h.)

ENT 535 Biological Control - Practical and theoretical aspects of arthropod control by entomophagous insects and the place of biocontrol in integrated control porgrams. (3 s.h.)

ENT 536 Insect Pathology - Diseases of arthropods and some aspects of microbial control of insects. (3 s.h.)

Courses in non-credit programs

PL SCI 802 Use of Agricultural Chemicals

ENT 951 Animal Pests of Turf and Ornamental Plantings - Injury, life cycle, and control of animal pests important in the management of turf grass and ornamental crops. (2 s.h.)

INSTITUTION: RUTGERS - STATE UNIVERSITY OF NEW JERSEY

PROGRAM: Biology, Entomology and Economic Zoology

DEPARTMENT: Biology, Entomology and Economic Zoology

DEGREE: Bachelor of Science (B.S.), Bachelor of Arts (B.A.)
Master of Science (M.S.), Master of Philosophy (M.P.)
Doctor of Philosophy (Ph.D.)

CONTACT: Professor James T. Streu
Director of Graduate Programs in Entomology and Economic Zoology
JSH 203, Georges Road Laboratories, Cook Campus
Rutgers University
New Brunswick, New Jersey 08903
(201) 932-9774

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Biology Program at Cook College includes an option in Entomology. Students are introduced as undergraduates to the structure, physiology and the identification of insects. Basic biological studies and the chemical and biological aspects of insect management and control are also presented.

At the graduate level, the Department of Entomology and Economic Zoology offers specializations in economic zoology, insect toxicology, insect physiology, insect morphology, insect ecology, pesticide and residue chemistry, and medical entomology.

Undergraduates are prepared for positions as laboratory technicians or assistants, scouts with pest management programs, or clerical and support activities with EPA and other federal or state agencies. The undergraduate entomology major has been developed within the last five years in the Biology Department.

In order to obtain a full professional entomology background, ten years of study are required. Holders of master's degrees are qualified for positions in industry as laboratory managers for screening programs, as technical representatives, and as sales and development personnel. Master's graduates may work in support positions within industry or government in pest management programs. They are also qualified for county extension work.

Holders of the Ph.D. are qualified for university experiment station positions in teaching and/or research. They may find equivalent positions in teaching and/or research. They may find equivalent positions within industry, government (U.S. Department of Agriculture, etc.), and research firms. Graduates with post-doctoral experience are considered the most qualified for the best jobs in this field, according to Rutgers officials.

Rutgers University maintains a pesticide residue chemistry laboratory with related equipment for pesticide research. Each professor has an office and is assigned laboratory space. Field work is required for courses relating to such topics as ecology of salt marsh areas. Regular seminars are scheduled every week by the department. Occasionally workshops and symposiums, conducted at professional meetings, are attended by faculty and students. Pesticide training short courses, and educational outreach courses are also conducted by Departmental staff.

Most of the research funding obtained by the department is Federal Hatch funds (U.S. Department of Agriculture - Cooperative State Research Service). MacIntyre-Stennis funds are available for research relating to forestry problems. Extension service funds are obtained from the Smith-Liver Corporation. Most of the grant funds from agencies are "soft money" and Aphers funds are utilized for post-doctoral research.

PROGRAM REQUIREMENTS

In order to be considered for admission into the Entomology and Economic Zoology graduate program, prospective students must submit Graduate Record Examination scores, have a B average in undergraduate course work, have good letters of recommendation, and have a solid background in the sciences. Thirty credits of graduate course work are required for the master's degree, which may be awarded with substitution of additional classes and an essay for the thesis on the recommendation of the student's chairman and committee.

Candidates for the B.A. or B.S. degree in Biology must complete: thirty-six hours of college requirements, forty-four to forty-nine hours of required courses (twelve may be used to satisfy college requirements), and thirty-five hours of entomology (seventeen hours are required, and eighteen are option electives). A total of 128 credits are required for the bachelor's degree.

Financial available to undergraduates consists of the normal federally run programs (Basic Educational Opportunity Grants, etc.). Graduate students may apply for six graduate assistantships (fifteen hours of work per week for the university), two teaching fellowships and one endowed Headlee Fellowship. The Headlee Fellowship (from the pesticide industry) goes to the top student in biochemistry, physiology, toxicology, or entomology, for basic research.

CURRENT FACULTY, STUDENTS, GRADUATES

The Entomology and Economic Zoology Department has a total staff of twenty-two persons, which include 3.3 teaching lines and 18.6 research lines. Two members are one-third time for the research of mosquito control. Five persons are carried on Aphus annual contracts.

There are currently (fall, 1977) twelve to fifteen undergraduate entomology majors and thirty graduate students. Twenty-six students are full-time and four are part-time; 30 percent are female. Approximately three to four graduate students complete their degrees annually. Enrollment and numbers graduating have remained relatively stable over the past three years.

Students are not allowed to complete three degrees within the same department. Many continue for their doctorates at such institutions as the University of California at Berkeley (biological control); the University of Wisconsin (physiology); Michigan (pest management); and Cornell (physiology). Program officials estimate that virtually all graduates have secured employment in their field. The department maintains a notebook of employer positions, and this is said to be an excellent resource tool for students seeking employment. Most (70%) obtain jobs in the pest control industry (Dow Chemical, Dupont, etc.), and many (30%) find employment with public agencies (15% with EPA).

PROGRAM PROJECTIONS

The department may reduce its program somewhat over the next five years as five faculty members have left and only two will be hired as replacements. Both replacements are expected to be hired by early 1978. One have a behavioral physiology of insects background and the other has an insect ecology background with specialization in systems modeling. Enrollment is expected to be stable over the next five years, and no change in emphasis is anticipated. The Inter-regional Group 4 may expand greatly, however, and this group is currently engaged in a project of registering pesticides used on minor crops.

An undergraduate major in entomology with a pest management option may be developed within the department within the next five years. A new specialty area (mosquito biology and control) may also be developed at the graduate level.

Departmental officials forecast that the pesticide area will eventually become stronger in emphasis in response to governmental and public pressures for pesticide registration. They believe that the full impact of this pressure has yet to be met. The urban scene is large in scope and there are many related ornamental and public health problems associated with it. MMre extension personnel, especially medical entomologists, are needed to respond to the public health aspects of the public's needs. Urban entomology is an area which needs to be further developed.

COURSE DESCRIPTION

Undergraduate courses:

Ecology

Invertebrate Physiology

Insect Structure

General Entomology

Insect Classification

Statistics

Graduate courses:

Mosquito Biology and Control - The anatomy, physiology, and bionomics of mosquitoes with emphasis on current techniques. (3 cr.)

Biological Control of Insect Pests - The concepts and methods involved in the control of harmful insects. (3 cr.)

Principles of Systematic Entomology - Methods of contemporary systematic research. (3 cr.)

Insect Structure and Function - Topics deal with response systems, sensory systems, energy utilization, transport and secretion and renewable systems. (4 cr.)

Insect Pathology - Principles of insect pathology and invertebrate immunity. (3 cr.)

Insect Physiology - The physiological systems of insects with emphasis on those systems peculiar to this class and suitable as targets for insect manipulation and control. (3 cr.)

Toxicology of Economic Poisons - The principles of pesticide action. (3 cr.)

Advanced Studies in Insecticides - The student selects a short research problem in the area of insecticides, their formulation and application, apart from thesis research. (3 cr.)

Seminar in Entomology - Weekly conferences to discuss current entomological topics.

INSTITUTION: UNIVERSITY OF CALIFORNIA, DAVIS

PROGRAM: Entomology

DEPARTMENT: Entomology

DEGREE: Bachelor of Science (B.S.), Master of Science (M.S.), Doctor of Philosophy (Ph.D.), Entomology

CONTACT: Dr. Donald L. McLean
Professor and Chairman
Department of Entomology
University of California, Davis
Davis, California 95616
(916) 752-0483

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Entomology is one of three in the University of California higher education system, and dates back to 1905. The department offers the B.S., M.S. and Ph.D. degrees. Administered through the department is a new M.S. program in plant protection and pest management which is also included in this narrative.

The faculty and the students have a common goal in their research activities. Through methods that are both economically and ecologically sound, research is aimed at the advancement of food production and its quality, as well as the protection of people and livestock. The concept of integrated pest management is endorsed by all members of the department. The departmental philosophy is predicated upon the concept of diversity, rather than the unilateral development of a pest management program.

The academic emphasis of research, at both the undergraduate and graduate level, revolves around four major areas. These areas are as follows: apiculture (bee biology); insects affecting plants; insects affecting animals; and, insect biosystematics.

The entomology major provides students with opportunities for extensive study of insects through utilization of a full range of laboratory and field equipment for research. The department possesses transmission and scanning electronic microscopes, and a variety of equipment for physiological and biomedical research. UC Davis has one of the nation's most advanced research and teaching facilities for students in bee biology. In addition, a wide range of other campus laboratories include a cyclotron and facilities for advanced instrumentation for cooperative research.

PROGRAM REQUIREMENTS

Students in the Bachelor of Science program gain a broad background in insect behavior, classification, structure, physiology and ecology. The graduation requirements are as follows: 77 quarter units of preparatory subject matter (general biology, chemistry and math courses); 28 quarter units of depth subjects (entomology courses); 36 quarter units of breadth subjects (English and the humanities); and 39 quarter units of unrestricted electives.

Students pursuing a Master's degree have the choice of a thesis requirement (Plan I) or a comprehensive oral examination with no thesis (Plan II). Students must complete, under Plan I, a minimum of 30 quarter units of upper division and graduate work. At least 12 of the 30 units must be graduate work in entomology. In addition, a thesis reporting the results obtained in an original research project must be prepared for approval by the Thesis Committee. The course requirements for Plan II students include 36 quarter units of formal course work, with 18 quarter units in the graduate course series in entomology (or nematology or environmental toxicology). No more than nine quarter hours of research may be used in satisfying the total 36 unit requirement. A comprehensive oral examination is also required.

Following completion of the M.S. degree, students wishing to continue for the Ph.D. degree, must submit a petition to the Graduate Student Advisory Committee. Continuation into the Ph.D. program is not automatic. Ph.D. students must take seven quarter hours of seminar, five in four different areas of entomology. The student must show, by means of a dissertation, an ability to make an original contribution to the knowledge of the chosen field and must demonstrate the ability to work independently.

CURRENT FACULTY, STUDENTS, GRADUATES

The teaching faculty is composed of 24 professional entomologists and nematologists. The undergraduate enrollment ranges from 70 to 80. At present, 20% are women and 10% are foreign students. Between eight to 15 B.S. students graduate per year.

Graduate enrollment is about the same as the undergraduate program (70 to 75 full-time students). About half of the graduates receive some form of financial assistance. The graduate students are composed of 20% foreign students and 10% women. The average number of students completing their M.S., per year, is five. The number of Ph.D.s granted each year ranges from zero to six.

Graduates of the department on all levels have little trouble finding employment. Over 90% of the baccalaureate graduates become employed in a related field of study with 70% in private companies and 30% taking jobs with the government. These percentages remain the same for master's students. Virtually 100% of the Ph.D. students find employment in their field. The majority, however, acquire teaching positions at the university level.

PROGRAM PROJECTIONS

The Department of Entomology at Davis expects to remain stable over the next five years. Major changes in faculty (other than replacements) or student population are not expected. Employment opportunities in the field remain bright due to the high number of predicted retirements in entomology throughout the nation.

COURSE DESCRIPTION

Undergraduate courses:

100 General Entomology - Biology of insects including morphology, physiology, development, ecology, classification of orders and common families, and relation to human welfare. (5 q.h.)

101 Insect Structure and Function - General principles of the evolutionary, functional and comparative aspects of insect morphology. (4 q.h.)

102 Insect Physiology - Basic mechanisms and processes by which insects maintain themselves and adapt to the environment. (4 q.h.)

103 Systematic Entomology - The principles of animal taxonomy, speciation, introduction to classification and nomenclature. (4 q.h.)

104 Insect Ecology - Application of basic theory to management of pest insect populations with focus on biological control and related approaches. Community structure and dynamics. (4 q.h.)

105 Insect Classification - Principles and methods of classification of insects to the family level with emphasis on identification. (3 q.h.)

109 Field Taxonomy and Ecology - The study of insects in their natural habitats; their identification and ecology. (7 q.h.)

Graduate courses:

201 Theoretical Aspects of Pest Management - The theory of crop ecosystem analysis and modeling using various crop-pest models. (3 q.h.)

202 Advanced Insect Physiology - Selected topics of insect physiology. Intensive study of topics of current interest, which will vary from year to year. (2 q.h.)

202L Advanced Insect Physiology Laboratory - Investigations of selected aspects of insect physiology. Independent projects may be undertaken. (2 q.h.)

219 Advanced Apiculture - Current topics in bee biology with special consideration of morphology, caste determination, queen rearing, nutrition, physiology, pathology, and products of honey bees. (4 q.h.)

245 Pollination Ecology - Theory of ecological relationships between plants and their pollinators with emphasis on insect pollination. (4 q.h.)

253 Advanced Medical Entomology - An analysis of several arthropod-borne diseases of man with emphasis on the relationship of the biology of the vector to the ecology of the disease. (4 q.h.)

255 Electrical Principles Related to Entomological Research - Basic electrical principles of ac and dc circuits. Methods of electrical measurements, discussion of semiconductor devices, and basic circuits of power supplied, amplifiers, oscillators, and electronic switching are presented in relation to biological measurement systems. (4 q.h.)

275A Principles and Methods of Entomological Research - Philosophy of research and principles of scientific enquiry related to entomological science. (4 q.h.)

275B Principles and Methods of Entomological Research - Principles of scientific enquiry related to entomological science with emphasis on the synthesis of research results for written and oral presentation. Development of skills in scientific communication. (4 q.h.)

INSTITUTION: UTAH STATE UNIVERSITY

PROGRAM: Pest Management

DEPARTMENT: Entomology

DEGREE: Bachelor of Science (B.S.) in Pest Management
Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in Entomology

CONTACT: Dr. Ting H. Hsiao
Associate Professor, Entomology
Utah State University
Logan, Utah 84322
(801) 752-4100

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Pest management is a new program at USU which is being administered by the Department of Biology. This program was established in 1976, but the area of pest control has been incorporated into the sciences curricula of USU since the early 1920s. Basically, pest management utilizes all methods of pest control which are environmentally safe. Program graduates enter the following occupations: pest management specialist; pest control consultant; extension specialist; and supervised control agent.

Students wishing to pursue advanced degrees in areas related to pest management may apply to the Graduate School for admission to the Master of Science and Doctor of Philosophy degree programs in Entomology.

The programs are accompanied by a voluntary internship plan which lasts from mid-spring through the summer. The students receive no credit while pursuing this activity but they are paid the equivalent of technician level salaries. Other students become involved with research projects during this time. Still others enter short term training arrangements with private companies. Usually the latter are most difficult to obtain as the private sector companies prefer experienced personnel.

PROGRAM REQUIREMENTS

At the baccalaureate level, all students must complete 45 quarter hours of general education courses. Students must also complete the following quarter hours: 54 credits in biology; 14 credits in chemistry; 13 credits in plant science and soils; 10 credits in physics and mathematics; and, 16 credits in agricultural economics, statistics and computer science. A minor which consists of 18 quarter hour credits is also required of pest management students.

The minor is chosen, usually, from natural resources, agriculture, business or science.

Students who have graduated from an accredited college or university may be admitted to the School of Graduate Studies only if they have been accepted by the department. Entrance requirements and admission procedures vary according to the graduate level of the applicant and the standards of the department.

The minimum credit requirement for the M.S. degree is 45 quarter hours, which includes 9-21 credits for research and thesis.

The requirements for the Ph.D. include at least three years full-time graduate study above the B.S. and at least two years above the M.S. The requirements also include 135 approved graduate credits (90 credits in addition to the masters degree) of which 45 credits should be devoted to research and the thesis.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty is composed of 12 full-time personnel. The equivalent of four are teaching and the equivalent of eight are involved in research activities. Of the total, 10 are cost-centered and the remaining two are University Extension entomologists.

Student enrollment in the entomology and pest management programs totals 26 full-time at present. There are 10 baccalaureate students, 50% male and 50% female. At the masters level there are also a total of 10, 70% male and 30% female. There are six male doctoral students. All of the students described, are full-time, as there were no figures available for the part-time student enrollment. In addition, it may be noted that 40% of the total number of USU biology students are involved in the entomology-pest management programs detailed above.

The average number of per annum graduates for these programs is approximately 10. The total includes approximately five B.S., four M.S., and one-half to one Ph.D. The majority of graduates at the B.S. and M.S. choose to continue their education in pursuit of higher degrees. It has been estimated by the faculty that 80% of the baccalaureate students and 90% of the masters students elect to continue their education. Those graduates who choose a career path, readily gain entrance into occupations in the private and public sectors. Upon completion of their doctoral studies, at least 50% of the graduates enter teaching professions at the post-secondary level.

PROGRAM PROJECTIONS

The pest management program at Utah State University will experience growth, especially during the next two to three years. The departmental faculty, however, anticipate that growth and expansion will be controlled. Utah is an agricultural state, but the population would not be able to absorb large numbers of graduates into pest management related occupations. Graduates would be forced to seek employment outside the state.

The current faculty is considered to be an adequate number to serve the growing pest-management programs during the next two to three years. Student enrollment should increase at all levels.

The most substantial program development will be the proposed changes at the masters level. At present, pest management students at the masters level are awarded the Master of Science, Biology (Entomology). The proposed new degree would allow pest management to be noted in parentheses on the degree. No time-lines have been established for this proposed change.

COURSE DESCRIPTION

Undergraduate courses:

Bio 120 General Biology - Chemical basis of life; cellular organization and function; nutrition, respiration, synthesis. (5 q.h.)

Bio 121 General Biology - Organismal structure, function, development, behavior, and ecology. (5 q.h.)

Bio 384 General Ecology - Interrelationships between plants and animals and their environments at the level of individual organisms; species populations, and ecosystems with emphasis on the structure and function of the latter two, and human implications. (5 q.h.)

Bio 385 Field Ecology - Sampling theory and methods in ecology, characteristics of aquatic, montane, and desert ecosystems. (2 q.h.)

Bio 480 Undergraduate Problems - Special directed studies on current problems and research in biology utilizing the literature, seminar, or laboratory as determined by discussion with faculty. (1-3 q.h.)

Ent 191 Biology of the Honey Bee - The elements of biology, behavior, and practical management of beekeeping are considered. (2 q.h.)

Ent 329 General Entomology - A fundamental, generalized presentation about insects, their structure, physiology, life, and seasonal cycles, classification, ecology, evolution, and principles of management and control. (5 q.h.)

Ent 530 General Entomology - Classification and identification of insects with emphasis at family level. (3 q.h.)

Ent 531 Principles of Entomology - Morphology and function of external insect structures. (3 q.h.)

Ent 532 Principles of Entomology - Function and structure of internal systems of insects. (5 q.h.)

Ent 533 Principles of Entomology - Introduction to ecology, behavior, and physiology as related to mechanisms of adaptation in insects. (5 q.h.)

Ent 535 Medical Entomology - Arthropods affecting the health of man. Includes recognition, habits, disease transmission, and control. (3 q.h.)

Ent 536 Insect Pollination in Relation to Agriculture - Includes beekeeping as related to crop pollination, utilization of native pollinating insects, and special problems in the pollination of many commercial crops. (2 q.h.)

Ent 537 Aquatic Entomology - Recognition, habitats, adaptations, and life histories of aquatic insects. (3 q.h.)

Ent 539 Economic Entomology - Insects related to economic pursuits of man. Includes recognition, damage, benefits, and control. (5 q.h.)

Ent 540 Forest Entomology - Life histories, ecological relationships, and recognition of major beneficial and harmful forest insects. (4 q.h.)

Ent 541 Pest Management Methods - Brings the concepts of pest control (insects, diseases, nematodes, and weeds) together within the context of total pest management. (4 q.h.)

Ent 542 Pest Management Field Course - Supervised training in pest sampling, identification, evaluation, and decision-making. (5 q.h.)

Ent 544 Arthropod Parasites of Domestic and Wild Animals - Recognition, life histories, and disease relationships of arthropods parasitizing domestic and wild animals. (3 q.h.)

Ent 565 Agricultural Sprays and Dusts - Preparation, properties, and uses of fungicides, insecticides, herbicides, and growth regulators. Operation and care of application equipment. (5 q.h.)

Plant Sci 250 World Food Crops - Understanding and appreciating the task of producing the crops to feed the world. Food production centers as related to climate, latitude, altitude, soils. Human influence through breeding, irrigation, fertilizers, and pesticides. (3 q.h.)

Plant Sci 555 Weed Science - Identification of weeds, weed problems in agriculture, and methods of control. (4 q.h.)

Soils 358 General Soils - A study of soil formation, physical and chemical properties, fertility, and management. (5 q.h.)

Botany 550 Principles of Plant Pathology - Fundamental principles underlying disease in plants. (5 q.h.)

Bio 512 Principles of Genetics - Illustrative material is taken from animals, plants, and humans. (5 q.h.)

Computor Sci 340 Computer Programming (FORTRAN) - The use of a problem-oriented programming language in solving problems by means of a computer. (3 q.h.)

Applied Statistics 431 Statistical Methods for Students Without Calculus - Descriptive statistics and probability, sampling, inferences about populations, estimation, hypothesis testing, regression and least squares, analysis of variance and covariance, experimental designs. (5 q.h.)

Graduate courses:

Ent 630 Advanced Systematics - (3 q.h.)

Ent 631 Insect Ecology - (3 q.h.)

Ent 633 Insect Physiology - (5 q.h.)

Ent 635 Insecticide Toxicology - (3 q.h.)

Ent 636 Insecticide Toxicology Laboratory - (2 q.h.)

Ent 637 Biological Control of Insect Pests - (3 q.h.)

Ent 685 Seminar in Entomology - (1 q.h.)

Ent 692 Special Problems – (1-6 q.h.)

Ent 697 Thesis Research - (1-2 q.h.)

Ent 699 Continuing Graduate Advisement - (1-3 q.h.)

Ent 797 Dissertation Research - (1-12 q.h.)

Ent 799 Continuing Graduate Advisement - (1-3 q.h.)

INSTITUTION: MISSISSIPPI STATE UNIVERSITY

PROGRAM: Specialized Training in Pest Management

DEPARTMENT: Entomology, Plant Pathology and Weed Science

DEGREE: Master of Agriculture

CONTACT: Dr. Woodrow W. Hare
Head of Plant Pathology and Weed Science
College of Agriculture
Mississippi State University
Mississippi State, Mississippi 39762
(601) 325-3138

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The program leading to the Master of Agriculture with specialization in pest management is administered jointly by the Department of Entomology and the Department of Plant Pathology and Weed Science. A committee of entomologists, weed scientists and plant pathologists provide program direction and decision-making, and members serve as advisors to students in the curriculum.

The program of study was designed and implemented in 1972 to train students interested in implementing pest management principles, technology and practices. Opportunities for graduates are available as pest control specialists with regulatory agencies and chemical companies, and as pest control consultants in private practice.

Although the pest management curriculum is not research-oriented, but geared toward practical application, faculty members in the participating departments have been heavily involved with research in this field. Development of crops resistant to disease and insect infestation has been a high priority; for example, a tomato is being developed that is strongly resistant to rot. Crops resistant to root-knot nematodes, fungi, and viruses have been developed and released, preventing the need for fungicide application. Other areas of research and priorities include cotton pest management, integrated control of arthropods of public health importance, forage and grain crop insect pest management, insect vector-path-plant interrelationships, biological disease control, and herbicide residues.

The M.A. program in pest management emerged in part from the impetus of federal pesticide legislation in 1972; however, the Department of Plant Pathology and Weed Science had been implementing the similar plant protection option in the B.S. program since 1967. The master's program was approved in 1973; the first graduate was produced in 1974.

PROGRAM REQUIREMENTS

Entrance into the program requires a bachelor's degree from an accredited institution, and an acceptable grade point average and GRE score. To meet the entrance requirements of the pest management program, students have usually graduated from the undergraduate entomology or plant pathology and weed science programs. Approximately twenty-seven hours of prerequisite courses must be fulfilled, including specified courses in botany, entomology, agronomy, and plant pathology and weed science. Students wishing to do graduate work in this area must be accepted by both the student's pest management committee and the department of affiliation.

Candidates are required to work under the direction of an advisory committee, satisfactorily complete a minimum of thirty semester hours of required courses, complete one hour of internship, and pass a final comprehensive examination. A student's advisory committee is appointed by the curriculum coordinator, and includes one member from each discipline and the coordinator. One member of the advisory committee serves as the student's major advisor.

Required courses in the master's curriculum include ten hours in entomology, ten in weed science, and ten in plant pathology. One hour of internship is also required; students spend the summer term working with specialists in the field, often with the Mississippi Cooperative Extension Service. There are no assistantships available or any special support funds for this program.

CURRENT FACULTY, STUDENTS, GRADUATES

Eight faculty members from the two participating departments serve on the pest management committee; these are the persons most involved with teaching and research in pest management. Sources estimate that fifteen percent of their time is spent with teaching and the remainder chiefly with research. None serve this program full-time. Three adjunct professors from the U.S. Department of Agriculture serve on committees of students in pest management.

Seven students from the Department of Plant Pathology and Weed Science are enrolled in the pest management curriculum, as well as an estimated eight from the Department of Entomology. An average of three to four persons have graduated with this specialty annually in recent years. This estimate represents a gradual increase from the program's inception.

Several graduates have opted to pursue the Ph.D. degree at various institutions. Of the remainder, program sources indicate that all have been successful at securing employment in the pest management field. An estimated 40 percent become employed with chemical companies, 20 percent with governmental organizations, and approximately 40 percent become consultants in private practice. Faculty members assist with graduate placement, and each graduate receives at least ten job offers.

PROGRAM PROJECTIONS

Program faculty believe that the number of students in this curriculum will continue to grow as awareness increases concerning job opportunities available. The demand for specialists of this nature is not likely to decrease or level off. The exact nature of this curriculum in the future will be contingent upon results of continual in-house reviews and evaluations. If necessary or advised, curriculum modifications will be made.

ADDITIONAL INFORMATION

Program officials have noted that enhanced cooperation between the Environmental Protection Agency and university pest management experts could be very beneficial. One main area that this cooperation is advised is in the development of practicable and realistic regulations issued pursuant to federal legislation.

COURSE DESCRIPTION

ENT 6234 Field Crop Insects - Selected arthropod pests on agronomic and horticultural field crops. Classroom instruction includes recognition, biology, behavior, ecology, distribution, crop damage and losses, and pest management. Insect-host plant interrelationships emphasized in field observations and laboratory experiments. (4 s.h.)

ENT 6444 Medical and Veterinary Entomology - History and principles; relationships of epidemiology and etiology of pathogens disseminated by insects and other arthropods to humans and animals; collection and identification of causal agents, vectors, pests and parasites; control measures. (4 s.h.)

ENT 8743 Principles of Pest Management - Biological and ecological bases for insect control, approaches to pest regulation in pest management, and integrated systems of pest management. (3 s.h.)

PW 7713 Principles of Weed Control - The biology of weedy plants and planning control programs; interrelationships of agricultural operations with natural processes involved in introduction, spread, and persistence of weedy plants; herbicides; relationship of weed control to physiological processes of plant growth and development. (3 s.h.)

PW 8713 Advanced Weed Science - The interrelationships of herbicides, crops and weeds; the use and limitations of herbicides by chemical family; the effect of environmental and edaphic variales on herbicide efficacy; the persistence of herbicides in soil, water and the atmosphere. (3 s.h.)

PW 8724 Mode of Action of Herbicides - The concepts and principles

PW 8724 (Cont'd) - underlying herbicide selectivity and phytotoxicity; chemical classification of the 125-plus commercially important pesticides; the importance and impact of herbicidal additives on the action of herbicides; the physiological mode and the biochemical mechanism of action of herbicides. (4 s.h.)

PW 7114 Control of Plant Diseases - History and significance of plant pathology; scheme of classification of living organisms; types of organisms causing plant diseases, their reproduction and spreading; methods and principles of controlling plant diseases; symptoms, disease cycles, control measures of common crop diseases. (4 s.h.)

PW 8143 Advanced Plant Pathology I - Plant diseases that are difficult to diagnose correctly; fundamental and practical aspects of diseases due to environment, nematodes, nutrition, parasitic higher plants, and viruses. (3 s.h.)

PW 8153 Advanced Plant Pathology II - Dealing with problems posed by fungal and bacterial pathogens; research of pertinent literature and oral presentations. (3 s.h.)

ENT 7001 or PW 7001 Special Problems - Internship. (1-6 s.h.)

INSTITUTION: TEXAS A & M UNIVERSITY

PROGRAM: Entomology

DEPARTMENT: Entomology

DEGREE: Master of Science (M.S.) in Agriculture

CONTACT: Dr. R.E. Frisbie
Professor, Entomology
Texas A & M University
College Station, Texas 77843
(713) 845-7026

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The graduate entomology program was organized and instituted at Texas A & M University, through the College of Agriculture, in 1972. The major emphasis of the graduate programs includes several areas of specialization in entomological sciences. Illustrative of these areas of specialization are: toxonomy, morphology, parasitology, physiology, toxicology, ecology, and forest and urban entomology. Students are drawn to the Texas A & M University graduate programs in entomology, from across the southwestern United States. The current options include programs which lead to the Master of Science in entomology, the Doctor of Philosophy degree in entomology, and the Master of Agriculture degree in economic entomology. This narrative deals exclusively, however, with the Master of Science in the entomology degree program.

The university maintains modern, well-equipped laboratories which provide a variety of research opportunities for both graduate students and faculty. In-depth study possibilities are available through analytical equipment for biochemistry and insecticidal determinations, including radioisotope techniques, and insecticide toxicity analyses. Controlled temperature and humidity conditions allow for studies of insect biologies.

PROGRAM REQUIREMENTS

The Master of Science degree requires, normally, two years of approved entomological training at Texas A & M. There are comprehensive requirements in the biological sciences as well as in general and organic chemistry, which are required. Specific requirements are predicated upon previous training and professional experience. Generally a minimum of 32 semester hours is required for the thesis option.

Most students allocate a portion of their time to state and federal programs. This time may be considered an internship.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty total 32 full-time persons. In addition, there are 27 part-time faculty members involved in research, for a full-time equivalent total of 13 supporting persons. All 32 are cost-centered.

Currently the enrollment includes five male and one female for a total of six full-time students. There are no part-time students involved in this program, currently.

The graduates of this program average approximately two annually. For the most part, graduates enter employment upon graduation. Approximately 30% enter the private sector, 45% enter the public sector, and approximately 25% elect teaching and consulting fields for employment.

PROGRAM PROJECTIONS

This program, according to faculty and administrators, will experience expansion and growth over the next three to five years. The student population should illustrate growth as well as the faculty. In response to increased teaching and research needs, at least two faculty will be added to the staff within three to five years.

COURSE DESCRIPTION (selected)

Ent 601 Principles of Systematic Entomology - Principles, methods and history of systematic entomology. (3 s.h.)

Ent 602 Phylogeny and Classification of Insects - Phylogenetic relationships of the classes of arthropods with special emphasis on the evolution of insects. (3 s.h.)

Ent 605 Aquatic Entomology - Principles and practices concerning aquatic entomology. Emphasis placed on biology and classification of each group of aquatic insects. (4 s.h.)

Ent 607 Economic Entomology - Biologies, economic importance and control of insects and other arthropods from a pest management viewpoint are stressed. (4 s.h.)

Ent 608 Principles of Biological Control - Theory and practices relating to the role and utilization of natural enemies in arthropod population regulation. (4 s.h.)

Ent 610 Host Plant Resistance - Host plant resistance programs from the standpoint of the plant breeder, plant pathologist and entomologist. (3 s.h.)

Ent 615 Insect Physiology - Physiological processes of insects with emphasis on metabolism nutrition, neuro-endocrinology, nerve action, cell structure, respiration, circulation, excretion and flight. (4 s.h.)

Ent 617 Acarology - Systematics, morphology, physiology, and ecology of ticks and mites. (4 s.h.)

Ent 619 Insect Toxicology - Classification and properties of major types of insecticides. (4 s.h.)

Ent 620 Insect Biochemistry and Endocrinology - Emphasis on recent information and concepts in the area of insect biochemistry. (3 s.h.)

Ent 681 Seminar - Oral reports and discussions of current research and developments in entomology and related fields. (1 s.h.)

Ent 684 Professional Internship - On-the-job training in the fields of pest identification, home and garden pest control, medical and veterinary pest control, and pest management of food and fiber crop pests. (1-4 s.h.)

Ent 685 Problems - Entomological problems not pertaining to thesis or dissertation. (1-4 s.h.)

Ent 689 Special Topics in - Study of selected topics in an identified area of entomology. (1-4 s.h.)

Ent 691 Research - Research problems on taxonomy, life histories, biological control, ecology, and physiology of insects, and toxicology of insecticides. (1+ s.h.)

INSTITUTION: UNIVERSITY OF CALIFORNIA, DAVIS

PROGRAM: Plant Protection and Pest Management

DEPARTMENT: Interdisciplinary

DEGREE: Master of Science (M.S.) in Plant Protection and Pest Management

CONTACT: Dr. Oscar Bacon
Department of Entomology
University of California
Davis, California 95616
(916) 752-0483

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The plant protection and pest management program at Davis is an interdisciplinary graduate group with faculty drawn from several departments. The program stresses identification and correction of plant disease and pest management rather than research on specialized problems. Students acquire an understanding of economic feasibility and environmental effects. The core of the program includes diagnosis and control of plant pest problems, toxicology, legal ramifications, and equipment for chemical applicators. The program is quite flexible and through selective use of electives, a student may develop expertise in a particular area of interest.

Students that graduate from the program are qualified to enter professions such as agricultural consultants, farm advisors, pest control advisors and operators, industry sales and market development staff or farm managers.

PROGRAM REQUIREMENTS

Before students are admitted to the program, they are required to satisfy all the general requirements. The minimum preparatory requirements include inorganic and organic chemistry (with laboratory); statistics, physics, economics; and, the following biology courses with laboratory: botany, zoology, weed science, plant pathology, nematology, economic or agricultural entomology and soils. General ecology and plant physiology are also required before entrance to the program, but they need not be laboratory courses.

The Master of Science in plant protection and pest management conforms to plan II (non-thesis) which requires 36 units of upper division and graduate courses. At least 18 of the 36 units must be earned in graduate courses in the major field. A comprehensive oral final examination will be required.

CURRENT FACULTY, STUDENTS, GRADUATES

The number of faculty involved in the PPPM program totals 31, all with appointments in various departments. The majority of the faculty included in the program are from the Departments of Entomology (9), Plant Pathology (9); and, Botany (4). The remaining nine members are from Environmental Toxicology (3); Nematology (4) and Agricultural Engineering (2). Each faculty member spends about two-thirds of their time in research through their own departments.

At present, there are 16 full-time students enrolled in the program. The majority of the students have undergraduate degrees in one of the plant science areas. The program offers one teaching assistantship per semester. The average number of graduates, annually, ranges from four to six.

Graduates of the program enjoy a 100% employment rate with 80% in industry and 20% working for governmental agencies. Many of the graduates enter positions as agricultural consultants or farm advisors while a smaller number enter agricultural sales and market development.

PROGRAM PROJECTIONS

The program is only in the second year, and at present, there are no plans to expand or change the curriculum. There is, currently, no formal internship program; however, the curriculum committee is trying to initiate a work-learn program for six units of credit.

COURSE DESCRIPTION

Entomology:

170 Insect Pest Management - Field course in pest management principles and practices. Students participate in detection and sampling for pest and beneficial species and evaluation of damage and also plan and conduct experiments. (6 q.h.)

Agricultural Engineering Technology:

133 Aircraft and Ground Equipment for Crop Protection, Nutrition and Vector Control - Aspects of equipment and application techniques, related to the effectiveness of agricultural chemicals and biological materials. (1 q.h.)

133L Laboratory for Equipment for Crop Protection - Directed laboratory exercises and field trips to augment study in course 133. (1 q.h.)

Environmental Toxicology:

101 Principles of Environmental Toxicology - A unified introduction to principles underlying the use and environmental consequences of pesticides, food additives, and other chemicals. (3 q.h.)

138 Legal Aspects of Environmental Toxicology - Federal and California legislation concerning air and water pollution, pesticide use, food and feed additives, consumer protection, and occupational exposure to toxic substances; roles of Federal regulatory agencies; alternatives to governmental control. (3 q.h.)

201 Concepts and Systems of Plant Protection and Pest Management - Ecological perspective of agricultural systems, the role of pests in these systems, plant protedtion and pest management methods as modifiers of the systems and their componants. (3 q.h.)

202 (A,B,C) Diagnosis of Plant Pest Problems and the Control of Causal Agents - Diagnosis of problems and the assessment of losses caused by insects, pathogens, weeds, nematodes, and other pests; methods of determining infestation levels and establishing economic thresholds, and control of these pests with emphasis on integration of available management practices into programs. (3 q.h. each)

290 Seminar in Plant Protection and Pest Management - (1 q.h.)

INSTITUTION: UNIVERSITY OF CALIFORNIA, RIVERSIDE

PROGRAM: Pest Management

DEPARTMENT: Interdisciplinary Committee on Pest Management

DEGREE: Master of Science (M.S.) in Pest Management

CONTACT: Dr. William H. Ewart
Chairman of the Committee
Pest Management Program
Department of Entomology
University of California
Riverside, California 92521
(714) 787-1012

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The master's degree in pest management at UCR, initiated in 1974, is an interdisciplinary program offered jointly by the Departments of Entomology, Nematology, Plant Pathology and Plant Sciences. The curriculum is designed to provide students with instruction in the theory, principles and practices of integrated pest control in agricultural, urban and aquatic environments. The main objective of the program is to produce graduates who can approach problems of pest management from an interdisciplinary point of view. Students acquire an awareness of relationships within ecosystems, effects of external factors upon such systems, and how integrated pest control measures can best be devised economically and ecologically.

The program deals mainly with applied problems in pest management, and usually is a terminal degree. Because the program is not research oriented, student financial support is limited to about one to two teaching assistantships. Students desiring a more research oriented type of program are encouraged to complete their graduate work through the Department of Entomology, Plant Pathology or Plant Physiology which offer the Ph.D. degree. The M.S. in pest management requires neither a foreign language nor a thesis. Students are, however, expected to complete a one summer internship before graduation.

Career opportunities for pest management specialists include employment with state and federal agricultural, public health, environmental and recreational agencies. An increasing number of students also find employment with international development organizations, chemical manufacturing and food processing industries, and private agribusiness firms.

PROGRAM REQUIREMENTS

Prospective students must possess a B.S. or A.B. degree in the biological or agricultural sciences, or related fields. Undergraduate courses must include general and organic chemistry; general physics; general biology; statistics; economics; and courses in plant sciences; genetics; plant physiology; ecology; entomology; plant pathology; nematology; weed science and soils. Course deficiencies can be completed during the tenure of the program.

A minimum of 36 quarter hours of upper division and graduate work, with at least 18 units in graduate-series courses, must be completed before graduation. Students acquire practical work experience through the internship program. Routine work such as continued handling or application of pesticides, processing soil or plant materials will not satisfy the work experience requirements. Interns usually participate in one of four areas, i.e., crop production, research and development, surveillance or consulting.

While there are only five required courses totaling 15 quarter hours, including the internship, students have a wide range of elective courses in which to specialize. Elective courses must be approved by the student's advisor.

CURRENT FACULTY, STUDENTS, GRADUATES

Because the program is interdisciplinary in structure, there are approximately 12 faculty members directly involved plus an additional 24 faculty members that are indirectly involved in the program.

There are presently 20 full-time students enrolled in the program. There are no part-time students. It is hoped that this number will increase. Because the program is not research oriented, however, student support is limited. One solution to the problem would be student training grants.

The average number of graduates each year fluctuates from six to 10. About 50% of these students continue on to graduate school for a Ph.D. The entomology department at Riverside is one of the largest entomology departments in the U.S. The graduate program in entomology has been rated among the top four departments in the discipline. There are 42 students in the Ph.D. program with an average of eight to 12 graduates per year.

Because of the increased need for pest management specialists, over 95% of the graduates find employment in their field. There is a placement office on campus; however, most graduates are recruited directly by industry or governmental agencies.

PROGRAM PROJECTIONS

Programs in pest management appear to have a bright future and the program at UCR is no exception. Although there are no plans at present to develop a new degree program in pest management, i.e., B.S.

and Ph.D., the M.S. program does hope to increase its student enrollment with stronger state and federal support for students. The program at UCR is a quality program and plans to remain one of the top in the nation. Significant increases in the faculty are not anticipated over the next few years.

COURSE DESCRIPTION

201 Principles of Pest Management - Basic concepts for control of insects, plant pathogens, nematodes, and weeds in various types of plant communities. (3 q.h.)

202 Properties and Utilization of Pesticides - Properties of pesticides and their utilization in pest management systems; formulations and application methods, target-organism selectivity, factors affecting pest control efficiency, residues and their fate in the environment, hazards and regulations. (3 q.h.)

203 Formulation and Implementation of Pest Management - Theory and basis for the formulation, development, and integration of various types of control measures against insects, plant pathogens, nematodes and weeds. (3 q.h.)

204 Methodology of Pesticide Application - Principles, techniques and equipment utilized in the application of pesticides for the control of insects, weeds, plant pathogens and nematodes in agricultural fields and urban situations. (2 q.h.)

250 Seminar in Pest Management - Lectures and discussions by scientific and professional specialists in pest management. (1 q.h.)

290 Directed Studies - Practical experience in pest management equivalent to one summer to be accomplished by work experience or by an internship under the direction of an approved supervisor. (1-6 q.h.)

INSTITUTION: UNIVERSITY OF MARYLAND

PROGRAM: Pest Management

DEPARTMENT: Entomology

DEGREE: Master of Science Pest Management Option

CONTACT: Dr. Galen P. Dively
Symons Hall, Rm. 1304
Department of Entomology
University of Maryland - College Park
College Park, Maryland 20742
(301) 454-4239

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Initiated in June,1975, the Pest Management program is intended to train students as general practitioners in the theory and practice of integrated pest management. Interdisciplinary in structure, the program permits much individual specialization. Rather than require a thesis, the Pest Management Option combines course work with practical experience for two summers of internship programs. The program puts the student in a decision-making role, rather than theoretical, dealing specifically with the problem of lack of communication skills among graduates of environmental programs today.

The program has many support facilities available to the students. These include eight research farms and nearby research units of the federal government. The Agriculture Experiment Station is currently conducting more than two hundred research projects.

PROGRAM REQUIREMENTS

Students applying for admission to the Pest Management Option Program must have a B.S. degree with a major in Entomology or one of the plant or soil sciences. Students with other undergraduate majors may be admitted but they must complete all prerequisites and other courses before assuming regular status in the program.

A minimum of thirty semester hours are required with a minimum grade point average of B. There are thirteen credits of required course work and at least thirteen credits of supportive course work required in the program. Students are urged to choose supportive course work relevant to one of the three specialty areas within the program, Crop Pest Management, Urban Pest Management, and Man and Animal Pest Management. Each student enrolled in the Pest Management Option is required to take six credits of ENTM 789, Field Experience in Pest Management, usually offered in the summer. The student is assigned to two work-study areas for his/her applied study term, that relate to the student's specialization. Possible areas of study include: working as a field scout for a food processing company, as a scout for a county extension agent or grower group, as a field scout for a commercial sod producer, for pest exterminating company and other organizations concerned with Pest Management. The student is faced with responsibilities such as pest identification, pest population monitoring, decisions in control strategies, and application of control measures. The student is then required to write a report of each work-study assignment completed.

A number of University and private scholarships are available to the students.

CURRENT FACULTY, STUDENTS, GRADUATES

There are currently five teaching members on the Pest Management's program faculty. Four of the five devote time to both teaching and research. The department research funding is available from USDA, EPA and the Maryland Experiment Station.

There are currently eight males enrolled in the Pest Management program. Most of the eight are from Maryland. The program definitely attracts "career change" students, as Pest Management is a recently burgeoning field.

There are approximately two graduates per year. The graduates are well trained to go into a variety of areas. The occupations that the program sees its graduates going into include, pest management assistants, scout supervisors, county agriculture agents, special agents, consultants (private or business), food industry, nursery workers, ornamental greenhouse production, exterminators and health personnel. The graduates find employment through referrals from the department.

PROGRAM PROJECTIONS

As the program is still new, the staff definitely would like to see it expand. They hope to acquire two more faculty members in Research Personnel and Programming. The department plans to make the program more interdisciplinary, offering interdepartmental degrees. Two new courses are projected to be offered in the near future: Extension Entomology and Urban Entomology.

COURSE DESCRIPTION

(the following is a partial listing of courses)

ENTM 653 Toxicology of Insecticides - A study of the physical, chemical, and biological properties of insecticides. Emphasis is placed on the relationship of chemical structures to insecticidal activity and mode of action. (4 s.h.)

ENTM 654 Insect Pest Population Management - Current developments in pest management theory and practice. Emphasis on agro-ecosystem components and their manipulation. Population sampling, damage thresholds, cost-benefit relationships, and modeling in pest management. (3 s.h.)

ENTM 789 Field Experience in Pest Management - Involvement in practical problems of pest management in field situations. The student will be assigned to a problem area for intensive experience, usually during the summer. A final written report is required for each assignment. (1-6 s.h.)

ENTM 612 Insect Ecology - A study of fundamental factors involved in the realtionship of insects to their environment. Emphasis is placed on the insect as a dynamic organism adjusted to its surroundings. (3 s.h.)

Crop Pest Management:

AGRO 404 Tobacco Production - A study of the history, adaptation, distribution, culture, and improvement of various types of tobacco, with special emphasis on problems in Maryland tobacco production. Physical and chemical factors associated with yield and quality of tobacco will be stressed. (3 s.h.)

AGRO 405 Turf Management - A study of principles and practices of managing turf for lawns, golf courses, athletic fields, playgrounds, airfields and highways for commercial sod production. (3 s.h.)

BOTN 424 Diagnosis and Control of Plant Diseases - A study of various plant diseases grouped according to the manner in which the host plants are affected. Emphasis will be placed on recognition of symptoms of the various types of diseases and on methods of transmission and control of the pathogens involved. (3 s.h.)

BOTN 427 Diseases of Vegetable Crops - The techniques of pesticide evaluation and the identification and control of diseases of Maryland crops are discussed. (2 s.h.)

Urban Pest Management:

ENTM 453 Insect Pests of Ornamental Plants - The recognition, biology and control of insects and mites injurious to ornamental shrubs, trees and greenhouse crops. Emphasis is placed on the pests of woody ornamental plants. (3 s.h.)

ENTM 472 Medical and Veterinary Entomology - A study of the morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. (4 s.h.)

Man and Animal Pest Management:

ENTM 672 Culcidology - The classification, distribution, ecology, biology, and control of mosquitoes. (2 s.h.)

ZOOL 475 General Parasitology - A consideration of the phenomenon of parasitism through a study of the structure, function and host relationships of parasitic organisms. (2 s.h.)

INSTITUTION: HARVARD UNIVERSITY SCHOOL OF PUBLIC HEALTH

PROGRAM: Toxicology

DEPARTMENT: Physiology

DEGREE: Master of Science (S.M.)
Doctor of Science (Sc.D.)

CONTACT: Dr. Rudolph Jaeger
Department of Physiology
Harvard University School of Public Health
665 Huntington Avenue
Boston, Massachusetts 02115
(617) 732-1178

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The toxicology program at Harvard's School of Public Health provides students a basic background in biological, physical, and public health sciences and prepares them for professional careers in toxicological research. The current program was initiated within the Department of Physiology in 1965.

Toxicology is a flexible program, allowing for the nature and extent of a student's previous training and education. In addition to courses in toxicology, course work is generally required of all students in physiology, biochemistry, pharmacology, histology, biostatistics, epidemiology, and occupational health. Students are also permitted to select courses from other Harvard graduate schools and M.I.T.

Research facilities available to the program include the laboratories and equipment of the Kresge Center for Environmental Health.

PROGRAM REQUIREMENTS

Admission to the toxicology program requires, as a minimum, a B.S. degree with honor grades in science courses and a high score on the Graduate Records Examination. It is recommended that applicants have a strong undergraduate background in chemistry, biology, and physics or mathematics.

A minimum of two years of study is required for the S.M. degree. At least one academic year must be in residence at the University. Students must take eighty credit units of course work in toxicology and related subjects and are expected to devote at least twenty credit hours to research and make a significant contribution to a research project. A thesis is not required.

Full admission to Doctoral candidacy requires completion of a written and oral qualifying exam. After completion of the exams, students normally devote full-time to independent, supervised research in toxicology. A dissertation is required for completion of the degree program. Students normally complete the program in two to three years.

CURRENT FACULTY, STUDENTS, GRADUATES

There are currently two faculty members participating in the program, one part-time and one full-time. The part-time member devotes all his time to teaching while the full-time member spends about ninety percent of his time on research and the remainder teaching. Research funding comes from a variety of sources including the National Institute for Occupational Safety and Health and the National Heart, Lung, and Blood Institute.

Present enrollment consists of two full-time and two part-time students. Recruitment of students is not done on a formal basis, but students normally learn of the program through research activities or contact with faculty or alumni. The program also attracts several foreign students. All students currently enrolled in the program are receiving research assistantships. Previously, most of the students had received training grants.

Normally there is about one graduate from the program every two or three years. This fluctuates widely and in 1978, for example, there will be two graduates. Virtually all students find employment upon graduation, and most of them eventually end up in positions with government or industry. Initially, however, about seventy-five percent of the graduates work in research or academics. Program officials encourage students to get this experience before joining industry or government agencies. Placement of graduates is usually achieved through referral by faculty.

PROGRAM PROJECTIONS

Officials would like to expand the program to place more emphasis on the policy issues in toxicology, and increase the faculty by two to six members. No extimate is available on when such expansion might occur.

COURSE DESCRIPTION

Physiology 205 c,d Principles of Toxicology - This course deals with injurious effects of foreign chemicals. Emphasis is on basic toxicologic data leading to an understanding of such effects. Specific problem areas of public health are covered. (5 s.h.)

Physiology 205 a,b Seminar in Toxicology - This course will consist of seminars and discussion of topics in basic research, current literature reviews, applied problem areas and legislative matters in toxicology. (2 s.h.)

Physiology 210 c,d Advanced Toxicology - Topics include: selection, care and exposure of laboratory animals in toxicology; interpretation of toxicological data; disposition and enzymatic biotransformation of foreign chemicals; and other topics. (5 s.h.)

Physiology 300 a,b,c,d sum Tutorial Program in Toxicology - Opportunities are provided for individual tutorial work (reading and research) at a masters degree level. (no specified semester hours)

Physiology 350 a,b.c,d, sum Research in Toxicology - Doctoral candidates and other properly qualified students may undertake laboratory or field research by arrangement with the Head of the Department. (no specified semester hours)

INSTITUTION: OHIO STATE UNIVERSITY (OSU)

PROGRAM: Toxicology

DEPARTMENT: Pharmacology

DEGREE: Master of Science in Pharmacology
Doctor of Philosophy in Pharmacology

CONTACT: Dr. Daniel Couri, Director
Toxicology Division
Department of Pharmacology
College of Medicine
333 West Tenth Street
Ohio State University
Columbus, Ohio 43210 (614) 422-0168

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Since its inception in 1965, the toxicology program at Ohio State University has sought to prepare masters and doctoral students for careers in clinical, forensic, and environmental toxicology in government, industry, consulting, and academia. Training focuses on instrumentation, real-world science, and experimentation. Students, through discussions and laboratory work, gain "an appreciation of the biological and chemical aspects of chemical agents" which allow them "the versatility of (1) communicating with physicians who are primarily interested in the information upon which to base optimum care for their patients; and (2) seeking the approaches and the answers to the difficult questions of the mechanisms of chemical toxicity and drug interactions."

The Toxicology Laboratory in the Department of Pharmacology has for approximately fifty years provided toxicology service for the entire Central Ohio region. This service includes consultation and laboratory identification of chemical agents for county coroners, hospitals, and physicians. The principle function of the lab is to provide toxicological information and rapid identification of chemical agents for physicians in the clinical departments of University Hospitals.

Facilities available to students and staff include chemical identification and measurement equipment (visible-UV spectrophotometers, IR spectrophotometer, spectrophotometers, atomic absorption spectrometer, and instrumentation for gas chromatography and gas chromatography/mass spectrometry); centrifuges; radiation counting equipment (solid and liquid scintillation spectrometers); physiological monitoring and recording equipment; cytological equipment;

veterinarian-supervised animal facilities and a controlled environment chamber for small animal maintenance; and a photographic darkroom. Proximity to facilities in the College of Pharmacy and the Battelle Memorial Institute fosters cooperative studies with these agencies.

Current research funding from the National Institute of Health and the Environmental Protection Agency supports studies on the mechanism of action of indirect acting anticoagulants and Selenium metabolism and toxicity. A grant dealing with the pharmacology and toxicology of chlorine dioxide is now pending (EPA).

Though no formal internship program exists in the Toxicology program, students are continuously engaged in laboratory and clinical work. Those who obtain funding for grants they have written are given the total responsibility, under the Director's supervision, for staffing and directing the project.

PROGRAM REQUIREMENTS

The selection of graduate students in the Department of Pharmacology is "based on the excellence and breadth of a student's undergraduate training." Graduate Record Examination scores are required for both the general aptitude test and advanced tests in biology or chemistry. General requirements include qualification in general biology, organic chemistry, and mathematics (preferably calculus). The master's degree program requires coursework in biochemistry, physiology, and pharmacology, and a thesis. Doctoral candidates are held responsible for knowledge in biochemistry, physiology, pharmacology, statistics, and experimental design, and must pass a computer science of foreign language (can be waived) requirement.

CURRENT FACULTY, STUDENTS, GRADUATES

One full-time faculty member serves one part-time master's and seven full-time doctoral students currently enrolled in the OSU toxicology program. On the average, one Ph.D. and one M.S. degree are conferred annually; and enrollment is encreasing. Placement records indicate that 30 percent of the program graduates enter industry, 20 percent enter government, 10 percent enter consulting, and 40 percent enter university teaching. All students in the program receive some monies, either from grants or the toxicology fund (fees paid for laboratory work).

PROGRAM PROJECTIONS

Future plans call for increased curricular emphasis in industrial and environmental toxicology. The need to provide career-change opportunities for those now holding Ph.D. degrees--especially in forensic toxicology--may bring about a post-doctoral program in toxicology at Ohio State University. Faculty recognize a demand for trained personnel in these areas and a growing social, political, and scientific public consensus that we need environmental programs.

COURSE DESCRIPTION*

Pharmacology: 600 General Pharmacology - Introduction to the general principles of pharmacology, drug classification, and the sites and mechanisms of drug action. (U G 3 q.h.)

610 Toxicology and Drug Identification - The biochemical basis for the action of poison and methods for the identification of drugs and their metabolites. (U G 5 q.h.)

700 Medical and Mammalian Pharmacology - General principles of pharmacology; drugs used for diagnosis, prevention, or eradication of the cause of disease, including endocrine products and chemotherapeutic agents. (P G 4 q.h.)

701 Medical and Mammalian Pharmacology - Continuation of 700. (P G 5 q.h.)

702 Practice of Pharmacology - Performance and application of specialized pharmacological techniques and methods in evaluation of pharmacodynamic and pharmacokinetic activity of chemical substances. (P G 5 q.h.)

852 Drug Metabolism - Discussions of mechanisms of biotransformation of drugs by enzymes, pharmacologic characteristics of these systems, and techniques for the study of drug metabolism. (G 3 q.h.)

Pharmacy 700: Radioisotope and Tracer Techniques and Radiopharmaceuticals - A survey of the properties of radioisotopes and radiation; radioisotope tracer methods and applications to pharmaceutical sciences; the preparation, standardization, and handling of radiopharmaceuticals. (P G 5 q.h.)

Preventative Medicine: 820 Environmental Toxicology - A survey of major toxicological hazards that may be encountered in the working and residential environment with implications for human health and principles of control. (G 3 q.h.)

*U=undergraduate; G=graduate; P=professional

INSTITUTION: UNIVERSITY OF GEORGIA

PROGRAM: Entomology

DEPARTMENT: Entomology

DEGREE: Master of Science (M.S.), Masters in Plant Protection and Pest Management (M.P.P.P.M.), Ph.D.

CONTACT:
Dr. Preston Hunter, Chairman
Department of Entomology
University of Georgia
Athens, Georgia 30602
(404) 542-2816

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Entomology broke away from the Department of Zoology in 1954 with its B.S. degree and it began its M.S. in 1959, its Ph.D. in 1965, and most recently, the professional M.P.P.P.M. degree in 1974. The focus of this program is on research, particularly with respect to overall pest management techniques. The M.P.P.P.M. is administered jointly by the Departments of Entomology, Plant Pathology, Horticulture, and Agronomy.

The M.P.P.P.M. is designed to produce graduates with comprehensive multidisciplinary training in plant pathology, entomology, and weed science for employment by industrial, extension, and regulatory agencies. Positions exist for graduates with M.S. and Ph.D. degrees in the areas of teaching, research, control, and extension entomology in colleges and universities, experiment stations, state departments of entomology, the United States Public Health Service and in various private concerns doing pest control or insecticide compounding or manufacturing.

Students may conduct their research at the Athens campus or they may work under the direction of faculty at the Experiment Stations at Griffin or Tifton. Facilities and opportunities for studies in applied aspects of entomological problems are emphasized at these stations. On the Athens campus faculty jointly staffed with the College of Agriculture, the Institute of Ecology, and the Faculty of Parasitology enable students to earn a degree in Entomology with training in related disciplines. Faculty and specialized facilities are available for student training and research in acarology, agricultural entomology, apiculture, aquatic entomology, insect behavior, insect biochemistry, insect endocrinology, forest entomology, insect ecology insect histology, medical entomology, morphology, physiology, radiation entomology, systematics and toxicology.

During the period between 1965 and 1969 a NSF grant was secured for the purpose of developing the Biological Sciences, which includes Entomology, into a "Center for Excellence". The State of Georgia matched NSF's commitment and the ten million dollar grant was invested in faculty development, from five to eighteen (in Entomology), and to the expansion of research capabilities with additional technical instrumation. Specialized research facilities within the Entomology Department include controlled environment rooms and insectaries, greenhouse space, gas chromatographs, radiation counting equipment, spectrophotometers and exceptional insect and mite collections. Facilities outside the department which are available for use include electron transmission and scanning microscopes, computer facilities, forest research area, and the U.S. Department of Agriculture and Forestry laboratories. Particularly good library facilities in Entomology are available.

PROGRAM REQUIREMENTS

For entrance into the M.S. and M.P.P.P.M. programs the applicant must submit GRE scores, have a B.S. degree in an appropriate area, and have exhibited academic excellence in undergraduate programs. Entrance to the Ph.D. requires GRE scores, academic excellence, preferably an M.S. degree, and proficiency in one language in addition to English. Students whose backgrounds satisfy all the basic entrance requirements, but who lack pertinent biological and agricultural courses, must enroll in selected undergraduate courses to remove the deficiencies.

A total of sixty-two quarter hours of graduate course work will be required to complete the M.P.P.P.M. Students will complete two internships, one in industrial and one research/extension. The first will come near the mid-point of the program and the second will be the final course requirement. There is no thesis or language requirement. Each candidate for the degree must pass final written and oral examinations.

The M.S. and Ph.D. degree programs are each individualized depending upon an individual's career objectives, the one constraint being that the program of study must constitute a logical whole. For the M.S. at least forty quarter hours of graduate credit, exclusive of thesis, is required, and at least one-third of this credit must be in courses open only to graduate students. The candidate must submit a thesis which shows independent judgment in developing a problem from primary sources.

The Ph.D. was established to provide qualified students with the opportunity to pursue research and other scholarly activities beyond the point that is possible in programs for the master's degree. A minimum of three years of study is required beyond the B.S. degree. There is no prescribed amount of work, rather, one must attain proficiency in research, breadth and soundness of scholarship, and a thorough acquaintance with a specific field of knowledge. Evidence of such attainment must be provided through presentation of an acceptable dissertation based on independent research and the passing of prescribed written and oral examinations.

Every student working toward a M.S. or Ph.D. degree is required to serve as a teaching assistant in at least one course every two years. Students intending to pursue a career of teaching or teaching/research should plan to acquire additional experience in teaching and teaching methods. Financial support comes from several sources. Of fifty-four students enrolled in one given year all but nine were receiving aid.

CURRENT FACULTY, STUDENTS, GRADUATES

The Department of Entomology is conducted by a total of sixteen faculty. They distribute their time to allow a third of their effort to teaching and two-thirds to research. Selected courses in the Department of Plant Pathology, Horticulture, and Agronomy supplement the basic offerings of Entomology.

There is a total enrollment of fifty-nine in the combined graduate programs in entomology. Thirty-two students are seeking the M.S. degree, twenty-five are pursuing the Ph.D. and the remaining two are involved in the M.P.P.P.M. plan. Only fourteen percent of the graduate students are Georgia residents. Twelve to fifteen persons graduate per year. To date, two people have earned their M.P.P.P.M. degree, thirty-seven the M.S., and thirty-six their Ph.D.

There have been two graduates of the M.P.P.P.M. program, both of whom are employed in commercial capacities. Of the thirty-seven M.S. graduates 1971-1977, one is teaching in a university, seven continued their study in doctoral programs, twenty-three are employed by State or Federal agencies, three are in the commercial employ, and three changed fields. Eleven of the Ph.D's teach/conduct research in universities, three continued their study with post doctorial work, fifteen found State or Federal employment, and seven found commercial employment.

PROGRAM PROJECTIONS

Gradually the department would like to see expansion of a team approach to pest management. Development in chemical ecology and developmental physiology, environmental entomology, and an agroecology approach will enhance the concept of team specialists.

It is anticipated that as the M.P.P.P.M. program becomes established the enrollment will increase sharply. While the thrust of this degree is toward skills application, the department focus will continue to be on research.

COURSE DESCRIPTION

The following represents a sampling of courses from which students may design their program.

AGY 888 Quantitative Aspects of Plant Breeding - Study of quantitative and population plant genetics and interrelationship with plant breeding, genetic and environmental variation relationship. Selection procedures and choice of type or variety. (5 q.h.)

AGY 860 Soil Physical Factors and Plant Growth - Fundamental relations resulting when plants are subjected to a varying physical environment. Emphasis will be placed upon effects of soil moisture as related to plant growth, nutrient uptake and other physiological processes. (5 q.h.)

ENT 640 Insect Behavior - Evolutionary approach to principles of behavior, with emphasis on reproduction, mimicry, insect-plant interactions and development of sociality. (5 q.h.)

ENT 650 Insect Ecology - Processes and functional aspects of insect population and community ecology with emphasis on interactions between structure and environment. (5 q.h.)

ENT 674 Applied Systems of Insect Control - Major applied insect control techniques excluding insecticidal. Advantages and limitations of these techniques including practicality, economics, environmental impact, etc. Integrated control systems for development of a pest management program. (5 q.h.)

ENT 677 Chemistry and Toxicology of Insecticides and Fungicides - Biology, use, metabolism, residue analysis, and impact of insecticides and their alternatives in agriculture and in the environment. (5 q.h.)

ENT 680 Introductory Acarology - Classification, ecology and biology of the major groups of mites. (5 q.h.)

ENT 682 Entomology in Natural Resources - Arthropods which are important in forest resources management, including timber, wildlife, and recreation. (5 q.h.)

ENT 816 Insect Endocrinology - Metabolism and physiological regulatory mechanisms in insects. Laboratory practice in microsurgical techniques for extirpation and transplantation of endocrine tissues. (5 q.h.)

ENT 860 Radiation Entomology - Application of radiation and radioisotope techniques to entomology, especially insect ecology and control of insect pests. (5 q.h.)

ENT 887 Insect Toxicology - Modes of actions of important classes of insecticides and other materials important to insect control, structure-toxicity relationships, insect metabolism, mechanisms of selective toxicity and resistance, and environmental considerations. (5 q.h.)

HOR 604 Advanced Olericulture - Production with review of experimental evidence. Emphasis placed on the ecology, nutrition, varietal development and selection, herbicides and other current cultural treatments. (5 q.h.)

PAT 613 AB (AGY, ENT, HOR) Internship in Crop Protection and Pest Management - Master's Plant Protection and Pest Management degree program. (1 q.h. each)

PAT 625 Plant Nematology - Morphology and taxonomy of plant parasitic nematodes, with emphasis on characters used in identification. (5 q.h.)

PAT 629 Bacterial Plant Pathogens - Plant pathogenic bacteria, their isolation, identification, inoculation and control. (5 q.h.)

PAT 630 Integrated Plant Pest Management - Integrates principles used in the control of various pests into a logical system of application. (5 q.h.)

INSTITUTION: UNIVERSITY OF PITTSBURGH

PROGRAM: Environmental Health Engineering/Industrial Hygiene

DEPARTMENT: Industrial Environmental Health Sciences

DEGREE: Master of Science in Hygiene
Master of Public Health in Environmental Health
D.S. in Hygiene
Ph.D. in Toxicology

CONTACT: Dr. Gerald St. Denis
Assistant Dean for Student and Alumni Affairs
Graduate School of Public Health
University of Pittsburgh
Pittsburgh, Pennsylvania 15260
(412) 624-3002

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Graduate School of Public Health's Department of Industrial Environmental Health Sciences offers specialized programs in four major areas and their subspecialities: industrial hygiene, toxicology, environmental health, and occupational medicine. The department's objective is to aid in the detection and management of health hazards generated by industrial activities which affect workers and the general population in their environment. Graduates are qualified to strive to improve the protection of health from the stresses of exposure to modern industrial agents, to aid in the assessment of the health cost, and to develop methods of reducing it. They carry out these functions in industry, government, and in academia.

The department has a variety of specialty programs which include: Acoustical Environmental Control; Air Resources Management; Industrial Hygiene and Air Engineering; Toxicology; and Environmental Health (Health Aspects of Water Quality, Environmental Health Planning).

The Graduate School of Public Health has a variety of modern research laboratories which include an anechoic chamber and a whole body counter, among others. Further research opportunities exist in the Pittsburgh area in county and state health departments, local industries, and local health and welfare departments.

PROGRAM REQUIREMENTS

In order to be admitted to the Graduate School of Public Health, a quality point average of 2.5 out of a possible 4.0 in undergraduate work is required. Grades which are earned in the major field of the applicant are assigned a greater weight in the evaluation for admission. To be admitted for the Master of Public Health degree, candidates must possess: a graduate degree from an acceptable institution, in a discipline relevant to public health or a bachelor's degree with substantial knowledge in a discipline relevant to public health; a minimum of six college credits in biology; a minimum of six college credits in behavioral sciences; and a minimum of three college credits in mathematics or in statistics. Students not having a previously earned post-baccalaureate degree must submit scores on the verbal and quantitative aptitude portions of the Graduate Record Examination. Additional requirements may be specified by the major department, division or program.

The Master of Science in Hygiene and the Doctor of Science in Hygiene in acoustic environmental control are currently being offered by the Department. These degree programs are being dropped, although some courses in the field of acoustics will continue to be offered. The current program requires three full terms of study and the completion of a satisfactory master's essay. The Doctor of Science in Hygiene in acoustic environmental control is a three year program offering an in-depth study of engineering control technology, as well as of physiological and psychological response to acoustic stimuli. Students will be trained to solve problems in virtually all situations involving human beings and the acoustic environment. Required are passing of preliminary and comprehensive examinations as well as presentation of a satisfactory doctoral dissertation.

The Air Resources Management Curriculum affords the engineer or scientist an opportunity to study management of air resources, including the physical properties of air pollutants, their sources and detection techniques. Students are offered the Master of Science in Hygiene degree in air resources. Six to eight credits of electives are required, as is completion of a satisfactory master's essay. A minimum of three full terms of study (September-August) is required.

In Industrial Hygiene and Air Engineering the Master of Science in Hygiene in industrial hygiene is offered. It is a one year program of study leading to a master's degree for physical or biological scientists or engineers. Master's students are also required to take six to eight credits of electives and write a satisfactory master's essay. A minimum of three full terms of study (September-August) are required. This program may be extended into a doctoral program with emphasis in a selected area of industrial hygiene or air engineering, e.g. industrial hygiene engineering, analytical methods, aerosol physics. Selected courses in the School of Engineering, departments in the natural sciences or the School of Medicine may be taken for credit by doctoral students who enroll in one of these areas.

In Toxicology, the Doctor of Science in Hygiene or the Ph.D. degree in Toxicology is offered to a limited number of candidates possessing a degree in the basic sciences. No specific requirements are enumerated for this multidisciplinary field but the program of study is selected from courses in the department and is supplemented with courses from the Departments of Biochemistry, Pharmacology, and Physiology.

In Environmental Health, degree programs leading to the Master of Public Health, Master of Science in Hygiene, and Doctor of Science in Hygiene are offered. The program is designed to educate the environmental health professional and to train specialists in health aspects of water quality. The Master of Public Health in Environmental Health curriculum is intended to offer the engineer, chemistry, biologist, or others the opportunity to concentrate on the planning and administration of environmental health programs. Other requirements include a topical essay; four terms of study; and detailed evaluation of a problem with original conclusions and recommendations. The Master of Science in Hygiene in Health Aspects of Water Quality degree program is intended to allow specialization in the field of water supply and pollution control with emphasis upon theoretical or applied research, administration of water supply and pollution abatement programs and planning. A minimum of four terms of study and completion of a satisfactory master's essay dealing with a topic of current interest in the field are required. The Doctor of Science in Hygiene degree program is tailored to suit individual candidate needs, and selected courses from other University departments related to the candidate's background and interests may be taken.

The Environmental Health Planning cooperative study program leads to the Doctor of Science in Hygiene degree. This doctoral program is a joint undertaking with the Urban Affairs and Planning Department of the Graduate School of Public and International Affairs. The program is composed of core studies in the fields of planning and environmental health, and an option in either of these areas can be selected for emphasis. Joint seminar courses and additional courses in the option must be taken by the program's students.

The Department of Industrial Environmental Health Services will offer an internship program for students with no previous work experience. Placement will probably be with local county and state health departments.

The Graduate School of Public Health annually receives a limited amount of funding for general purpose traineeships. The Department of Industrial Environmental Health has traineeships in industrial hygiene which provide $1,000 each toward each student's tuition costs. Pennsylvania students are eligible to apply for educational loans administered by the Pennsylvania Higher Education Assistance Agency. Loans of up to $1,000 per year in federal funds are available to qualified students enrolled in schools of public health under the Federal program of insured loans to graduate students in health professional schools.

CURRENT FACULTY, STUDENTS, GRADUATES

A total of 41 faculty members teach the curriculum offered by the Department of Industrial Environmental Health Sciences. Included are five full professors, one research professor, four associate professors, two research associate professors, and four research assistant professors. The department is further assisted by a research associate, thirteen adjunct professors, four clinical associate and assistant professors, and six lecturers. The five full professors have backgrounds in toxicology, water chemistry, industrial hygiene and air engineering, occupational health, and environmental health engineering. The two research associate professors have backgrounds in occupational health and water pollution control.

The department has a total enrollment of fifty-nine students; twenty-four are part-time. It is estimated that ten to fourteen new students enter each year. There are four graduating periods during the year, and students receive their degrees after their essays are completed. A total of thirty-one students received degrees during 1977 and many (48 percent) received degrees in indusgrail hygiene. Thirty-eight percent received degrees in environmental health, 10 percent in acoustical environmental control, and 3 percent in toxicology. The 1977 breakdown is as follows:

M.S. in Hygiene in Industrial Hygiene:	15
M.S. in Hygiene in Environmental Health:	6
Ph.D. in Hygiene in Environmental Health:	6
M.S. in Hygiene in Acoustical Environmental Control:	3
Ph.D. in Toxicology:	1
Total:	31

Most M.P.H. and M.S. in Hygiene degree graduates obtain positions with county or state health departments in administrative or research positions. Most doctoral graduates find academic positions and a few graduates have found positions with federal agencies.

PROGRAM PROJECTIONS

Because of budgetary considerations and lack of laboratory space, the Graduate School of Public Heatlh is expected to remain at present enrollment and staffing levels. No more than fifteen full-time students will be admitted in subsequent years into the department's programs. The principal changes will be the reduction of the degree and an internship program will also be developed for students enrolled in the industrial health program.

COURSE DESCRIPTION (SELECTED)

IEHS 201 Introduction to Occupational Health - The physical and chemical properties and the methods of measurement of industrial enviornmental hazards are discussed. Basic concepts of thermodynamics and chemical kinetics and properties and measurement of suspended particles, gases, toxic materials, heat, noise, ionizing and non-ionizing radiation. (4 s.h.)

IEHS 205 Introduction to Sound Stimuli and Auditory Functioning - Synthesizes the physical parameters of sound with anatomy and physiology of hearing. The course will be diercted toward the auditory and non-auditory effects of noise on humankind. (3 s.h.)

Introduction to Acoustics - This lecture course includes physics of sound, measurement and analysis of noise and vibration, industrial hearing conservation, and noise control practice. (2 s.h.)

IEHS 209 Noise Reduction - The basic physical principles are systematically developed. Topics include design of resistive and reactive mufflers, transmission through structures, vibration isolation, system performance and case studies. (4 s.h.)

IEHS 212 Dynamical Analogies - Equivalent circuits of mechanical anc acoustical systems are employed to determine system response. Techniques of Laplace transform and pole-zero diagrams are used to study system response. (4 s.h.)

IEHS 221 Special Studies in Industrial Environmental Health Sciences - Properly qualified students may undertake research for the master's essay requirement with the approval and under the guidance of a member of the staff. (s.h. to be arranged)

IEHS 231 Introduction-Health Apsects of Water Quality - This course deals with the history (microbiological, chemical and physical), nature, and control of waterborne disease. (2 s.h.)

IEHS 235 Sanitation of Natural Wastes - Studies physical, chemical and biological characteristics of natural waters; sources, types, and effects of pollution; natural purification processes; oxygen balance in polluted water; determination of waste assimilative capacity. (3 s.h.)

IEHS 237 Water Systems Measurement - Consists of lectures, laboratory, and field trips devoted to the chemical, physical, and biological analysis of natural and treated waters and stream flow. (3 s.h.)

IEHS 238 Current problems in Water Pollution Control and Abatement - Field trips to water pollution control and enforcement agencies. (1 s.h.)

IEHS 241 Topics in Environmental Control - Teaches the science and practics of food and milk sanitation, insect and rodent control, housing, accidental injury prevention, noise and its abatement, and community air pollution control. (4 s.h.)

IEHS 243 Solid Waste Management - Discusses the nature of solid wastes, their impact on the environment and potential for disease transmission, and the technology, management and planning utilized in their treatment and disposal. (2 s.h.)

IEHS 247 & 248 Joint Colloquium in Urban and Environmental Health Planning I & II - Issues in urban and environmental health planning; research interests of the faculty and the more advanced students. (1 s.h. each)

IEHS 249 Water and Waste Management - Class project in which an actual water pollution situation is investigated. (3 s.h.)

IEHS 261; 262; 263 Analysis of Airborne Contaminants I; II; III - Physical methods of the evaluation of working conditions; methods of evaluation of physical stresses in working environments; chemical methods of the evaluation of working conditions. (1 s.h.; 1 s.h.; 2 s.h.)

IEHS 266 Industrial Hygiene Practice - Familiarizes the student with industrial hygiene problems and applications in a variety of industries. (2 s.h.)

IEHS 268 Industrial Toxicology - Covers entry, action, and elimination of toxic materials, describes experimental methods of determining toxic limits, discusses the design of toxicology experiments,and the more important industrial chemicals. (3 s.h.)

IEHS 269 Principles of Air Resources - Introduces the student to the broad field of air pollution. The first half of the course deals with sources, economics, controls of air pollution and micrometeorology. The second half is devoted to atmospheric chemistry. (3 s.h.)

INSTITUTION: UNIVERSITY OF ROCHESTER

PROGRAM: Toxicology Training Program

DEPARTMENT: Department of Pharmacology and Toxicology; Department of Radiation Biology and Biophysics; School of Medicine and Dentistry

DEGREE: Master of Science (M.S.); Ph.D.

CONTACT: Dr. J. Crispin Smith, Program Director
Department of Pharmacology and Toxicology
University of Rochester School of Medicine and Denistry
Rochester, New York 14642
(716) 275-3911

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Pharmacology and Toxicology and Radiation Biology and Biophysics within the School of Medicine and Dentistry sponsor graduate study in environmental, reproductive, biochemical, behavioral, developmental, and inhalation toxicology. The program first initiated in 1966 concentrates on the quanitative study of actions of toxic substances at molecular, cellular, organismal, and population levels. Areas of specialization available to graduate students for study and research include: general toxicology and pharmacokinetics; inhalation toxicology and aerosols; reproductive and developmental toxicology; radiation toxicology; and experimental pathology of toxic agents. Toxicologists may find professional opportunities in: academic research and teaching; industrial research on the toxic hazards of raw materials, intermediates and products and; positions in governmental agencies that develop standards for safe use of chemical compounds and that monitor chemical pollution.

As the program is sponsored jointly by two departments, extensive facilities are available. Laboratory, library, and computing facilities are available for research from various schools of the University and the Environmental Health Sciences Center. The staff for the program are drawn from the jointly sponsoring departments.

PROGRAM REQUIREMENTS

Although undergraduates with Chemistry-biology majors are preferred, prospective applicants with strong undergraduate backgrounds in any science, mathematics, or engineering will be considered. Emphasis is placed on admitting students with a strong commitment to research and interest in toxicology. Early enrollment in the summer term may be required to make up any undergraduate deficiencies.

Students who are unable to devote more than two years of full-time studies but would otherwise be qualified for entrance to the Toxicology Program, are eligible to complete the requirements for the M.S. degree (Plan A) with thesis. The M.S. Degree under this plan normally requires completion of 30 credit hours and the usual requirement of 18 hours of correlated course work may be replaced by research credits in cases where students have had equivalent training. The Toxicology Program's M.S. requirements include: completion of a core course in Toxicology (Tox 521); a set of prerequisite and advanced courses focused on the chosen area of specialization (total of 18 hours of course and seminar credits); a Master's research project (Tox 495) conducted with the advice of the student's research director; and a Master's thesis.

The Ph.D. degree normally takes four years to complete. Doctoral students take the core course (Tox 521) and must have taken General Biochemistry (Ind 401) and Physiologic Regulations (PSO 508) as Prerequisites. They are involved in a research participation program and are expected to complete the required courses before the end of the second academic year. Ph.D. research may be started at the end of the first academic year. Before the end of the second year, a research advisor is chosen and a qualifying examination is taken; doctoral research is usually completed and presented for the final oral examination by the end of the fourth year. Other than the core, graduate courses are elected according to the students choice of area specialization and interests.

The Toxicology Training Program at the University of Rochester has received a grant from the National Institute of Environmental Health Sciences for three-year stipends. NIEHS grants are for pre-doctorate and post-doctorate students only and cover tuition and pay a stipend. However, there is no current stipend support for M.S. students in any of the federal grant programs. The grants which start in July, 1978 are standard government stipends which are $325 per month for pre-doctorate students and replace National Institute of Health training grants. Post-doctorate fellowships range between $10,000 to $14,000 per year in stipends and cover further training in toxicology including courses and seminars. The School of Medicine and Denistry also has grants, stipends, and tuition funds for persons not covered entirely under the three year grant. The University will provide funds to cover training for the final year of study and research to complete the doctorate requirements. Stipends are currently available from the National Research Service awards. All students will be considered for support who are accepted by the Toxicology Admissions Committee. The Toxicology Training Program covers the costs of tuition and fees, thesis costs, and research expenses for those accepted for support.

CURRENT FACULTY, STUDENTS, GRADUATES

Twenty faculty are main contributors to the Toxicology Training Program along with other select faculty from several departments. Students can select as research advisors any of one hundred faculty members connected with departments in the school. There is a high faculty to student ratio in that there are 300 basic science faculty members for 300 graduate students in the School of Medicine and Dentistry. This is a normal faculty/student ratio in medical schools.

A total of 26 students are currently enrolled in the Toxicology Training Program. Four students (two female) are in the M.S. program and twenty-two are enrolled in the doctorate program (five female). Approximately seven students receive their degrees annually on the average. About two students annually receive M.S. degrees and five students receive Ph.D.s. Enrollment may increase due to student interest in this field and as demand for graduates by employers increases. Training grants tend to attract additional students with broader interests in a variety of specializations in this field.

Although this program is designed to be terminal, a few students continue to other programs conducting similar research. As there are few environmental toxicology research programs offered at the University of Cincinnati, New York University, Harvard and the Massachusetts Institute of Technology. Virtually all students find excellect jobs in this field as there are relatively few environmental toxicologists being trained nationwide. Approximately one-third each obtain positions in government, the private sector and academia. Many students receive job offers a year prior to their completing their thesis.

PROGRAM PROJECTIONS

No new specific faculty members are expected to be recruited for the Toxicology Training Program as faculty from various departments are available to teach courses in areas in which the program is lacking. There are no changes expected in structure of the program although there may be some new courses added. There is likely to be a significant increase in enrollment due to the availability of financial aid and the fact that environmental toxicology is a burgeoning field.

COURSE DESCRIPTION

424 Evaluation and Control of Air Pollution - This course includes sampling procedures, instrumentation, filtration, precipitation, and other related subjects. (2 s.h.)

472 Standards for Exposure to Industrial Chemicals - The basic principles underlying the concept and uses of these numbers are discussed. The actual data used by regulatory and advisory bodies in establishing certain of these numbers are reviewed by the class and evaluated for validity, relevance, and general adequacy to the purpose. (1 s.h.)

493 M.S. Special Topics in Toxicology - Directed studies in the field of toxicology. Students work in faculty laboratories and take part in current research. (3-6 s.h.)

517 Compartmental Analysis - The mathematical methods of compartmental analysis and analog computation are taught as tools for developing and evaluating models used in studies of the entry of foreign substances into living organisms and their subsequent distribution, accumulation, and removal kinetics. (4 s.h.)

522 Toxicologic Pathology - A laboratory course in which microscopic sections of various lesions, mostly induced by toxic compounds, are examined. (1 s.h.)

524 Public Health Toxicology - Problems in evaluation of toxicological risks are considered. Emphasis is placed on large human populations exposed to low levels of toxic chemicals. (1 s.h.)

526 Ecology and Environmental Toxicity - Poisons in the environment are studied in terms of actions on living populations, ecological consequences, and social costs and benefits. (1 s.h.)

533 Behavioral Pharmocology and Toxicology - The two aims are to survey the principal techniques used to ask questions about the effects of chemical substances on behavior, and to examine current research findings. (3 s.h.)

570 Neurotoxicology of Environmental Contaminants - This seminar examines the action of a variety of substances on the central nervous system and on behavior, emphasizing the correlations between the neurochemical morphological effects and the impairment of behavior. (1 s.h.)

INSTITUTION: UNIVERSITY OF CINCINNATI

PROGRAM: Toxicology

DEPARTMENT: Environmental Health

DEGREE: Doctor of Philosophy (Ph.D.)

CONTACT:
Dr. Paul B. Hammond
Department of Environmental Health
311 Kettering Laboratory
University of Cincinnati Medical Center
Cincinnati, Ohio 45267
(513) 872-5745

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Toxicology program within the Department of Environmental Health at the University of Cincinnati was established in 1968. Since that time, it has shared in the philosophical and pragmatic commitment of the Department to preparing competent, qualified personnel in the environmental health sciences. As noted in a recent departmental report:

> Research training in the environmental health sciences represents one of the most critical areas of manpower education among the biomedical disciplines. The nation's concern about health hazards in the environment is growing in intensity. There is a heightened awareness that there are many health and ecological problems which need to be more closely and carefully identified, quantified, and probed in depth.

The recent passage of the Toxic Substances Control Act that mandates the study of all new chemicals into the environment testifies to this national concern. There is great demand for personnel trained in toxicology--the study of harmful effects of natural and man-made substances.

The Toxicology program at U.C. offers doctoral and post-doctoral training "designed to provide the student with the knowledge and experience necessary to qualify him to investigate toxicity and to develop new methods for the evaluation of toxicity." The student may elect one of four program options: (1) a general environmental toxicology program, or specialization in either (2) neuro-behavioral toxicology, or (3) carcinogenesis, mutagenesis, and teratogenesis, or (4) industrial toxicology. All four options share a "core curriculum which provides the student with a fundamental understanding of the physiological and biochemical principles which govern the uptake and disposition of foreign compounds and facilitate the maintenance of homeostasis. Basic laboratory, pharmacokinetic and statistical techniques for the acquisition and evaluation of data also are taught." Electives may be taken in "radiobiology, developmental biology, genetics, epidemiology, psychology, and neurophysiology."

Facilities available in the Department of Environmental Health include a tissue culture laboratory, trace metal research facilities, analytical laboratories, a pathology laboratory, clinical facilities for studies of human subjects, and extensive animal quarters. The Department has access to one of the nation's toxicology abstracting services. Both the Environmental Protection Agency (EPA) and the National Institute of Occupational Safety and Health (NIOSH) maintain nearby research units.

Federal research and training monies constitute the predominate source of faculty salaries in the Toxicology program. Current or recent funding from the EPA, National Institute of Health, National Science Foundation, and private grants has supported a variety of faculty research efforts. Among these investigations are the development of infant animal models for the study of neonatal lead exposure, neurophysiological and neurochemical responses to heavy metals, the metabolism and disposition of toxic substances with particular emphasis on halogenated hydrocarbons including PCB's, the nature of lung damage by sulfates, mechanisms of teratogenesis, and the role of nutritional factors in toxicity.

PROGRAM REQUIREMENTS

Applicants with a baccalaureate degree from an accredited university or college in any discipline of basic science such as chemistry, biology, or related fields; or individuals with advanced degrees in chemistry or a biological science may be admitted to the graduate program in toxicology. For admission to the general environmental toxicology program option or the industrial toxicology option, applicants should have at minimum a B.S. or B.A. degree, preferably in chemistry or biology, an introductory calculus course, inorganic and organic chemistry, physics and at least one course in zoology or biology. Physical chemistry is highly desirable.

Admission to the neurobehavioral toxicology "option" requires that applicants hold B.A. or B.S. degrees with majors in psychology or in chemistry, biology, or related fields, provided they have academic backgrounds in psychology sufficient to prepare them for the program. Their previous coursework should include at least experimental psychology, physiological psychology, and statistics; courses in sensation and perception, and experimental design are considered helpful.

The third program option in toxicology - carcinogenesis mutagenesis, and teratogenesis - requires that applicants hold B.A. or B.S. degrees in chemistry or biology and have taken courses in physical and organic chemistry, physics, and molecular biology. Courses in embryology and genetics are desirable.

Beginning in the spring quarter of the first year of graduate studies, the student spends one quarter (one-half quarter sessions during the summer) in each of four departmental laboratories of his/her choice. At the completion of the fourth rotation period (fall quarter of second year), the student selects a laboratory and advisor with whom to continue further research leading to the thesis. Thesis work generally begins toward the end of the second year and is usually completed within four years after enrollment in the program.

CURRENT FACULTY, STUDENTS, GRADUATES

Eight full-time faculty members, who split their time evenly between teaching and research, represent a broad spectrum of disciplines: biochemistry, medical pathology, physical organic chemistry, enzyme chemistry, cell biology, and pharmacology (3). There are twenty full-time students (two women) enrolled in the program. Since 1968, eight Ph.D. and two M.S. diplomas have been awarded with a current, stable average of five doctorates projected to be conferred annually in toxicology by 1979. Among the graduates, three took post-doctoral fellowships (one is now in industry), four entered industry, two accepted university positions, and one was initially employed by NIOSH. Three students have completed post-doctoral fellowships at the University of Cincinnati; two have remained as assistant professors and one works in a private toxicology laboratory. Graduate students receive annual stipends in excess of $4000 plus tuition.

PROGRAM PROJECTIONS

According to program personnel, with the available and potential training programs, there will be a shortage of graduates and facilities in toxicology for at least another five years. The Toxicology program at the University of Cincinnati has reached a plateau in terms of students. Additional faculty and space would be needed to increase the enrollment, but increases in funding to provide these are in part dependent on the mood of the populace. The political pendulum swing between whether the public feels threatened by toxic substances or whether it chooses to maintain its current life style will determine how forcefully the current legislation is implemented and consequently, the future manpower needs in toxicology. Curriculum modification in the University of Cincinnati program is continuous and motivated by the assumption that toxicology trainees must obtain a broad background but also some specialization to meet research needs in the field. Though there is no timetable established for it, the program would like to add one faculty member in inhalation toxicology - the study of toxic agents on the respiratory tract - to provide students with expert training in this important area.

COURSE DESCRIPTION

Core Courses (Selected):

29-904-876 Cellular Anatomy - Structure and organization of cells and cell systems. Designed for doctoral students in toxicology. (3 q.h.)

29-904-880 Toxicology II - The responses of target organs and systems to toxic agents, including mechanisms of uptake, distribution and excretion; lung, kidney, liver, skin, nervous system. (4 q.h.)

26-904-701,702,703 Environmental Health Seminar - Lectures and discussions covering a broad range of problems in environmental health led by guest speakers considered leaders in their fields. (1 q.h. each)

Other Courses (Selected):

26-904-707, 708, 709 Environmental Hygiene Technology - Lectures, demonstrations on problems arising from man's environment, industrial hygiene, air pollution fundamentals and practices. (3 q.h. each)

26-904-719,720,721 Topics in Clinical Toxicology II - Exposure, clinical effects, pathology, prevention and treatment of industrial toxicants for physicians. (1 q.h. each)

26-904-782 Toxicology I - Introduction - Entry, action and elimination of toxic chemicals; dose-response relationships; experimental toxicology, design, interpretation and application of the data. (3 q.h.)

26-904-787 Introduction to Biostatistics - Descriptive statistics, probability distributions, estimation sampling, types of error, significance level, test of hypotheses, sample size, correlation, linear regression. Emphasizes practical-applied aspects. (4 q.h.)

26-904-816,817,818 Clinical Toxicology and Pharmacology - Bedside rounds and seminars illustrating practice of clinical toxicology as applied to drug overdoses and poisonings by nontherapeutic agents. (2 q.h. each)

26-904-842 Toxicology Laboratory and Instrumentation - Laboratory dealing with pharmacological and toxicological manifestations in intact mammalian and in vitro systems. (3 q.h.)

26-904-881 Toxicology III - Toxicological applications of stable and radioisotopes, spectrometric, procedures, chromatographic methods, isolation, separation and identification procedures. (3 q.h.)

26-904-882 Toxicology IV - Biotransformation of toxic foreign compounds; chemical pathways of metabolism; comparative toxicology, extrapolation from animals to man. (3 q.h.)

26-904-883 Mutagenesis, Carcinogenesis and Teratogenesis - Lectures on the principles for testing environmental agents with mutagenic, carcinogenic and teratogenic activity, and their effects and mechanisms in biological systems. (3 q.h.)

26-904-885 Neurobehavioral Toxicology - Behavioral and neurophysiological concepts and techniques as applied to environmental and toxicological problems with laboratory and demonstrations. (3 q.h.)

26-904-896 Environmental Teratogenesis - Lectures and discussions covering principles and methods of teratogenicity testing, description of prominent environmental teratogens, and their mechanism of action. (3 q.h.)

26-904-910 Industrial Toxicology Practice - Medical, toxicological evaluation of industrial materials, consumer products. Offered alternate years. (3 q.h.)

26-905-791-5;891-5;991-5 Special Topics - Toxicology - Seminars or tutorial sessions dealing with special topics in toxicology as related to research and application basic to field of environmental health. (arranged)

INSTITUTION: UNIVERSITY OF IOWA

PROGRAM: Environmental Toxicology

DEPARTMENT: Institute of Agricultural Medicine and Environmental Health

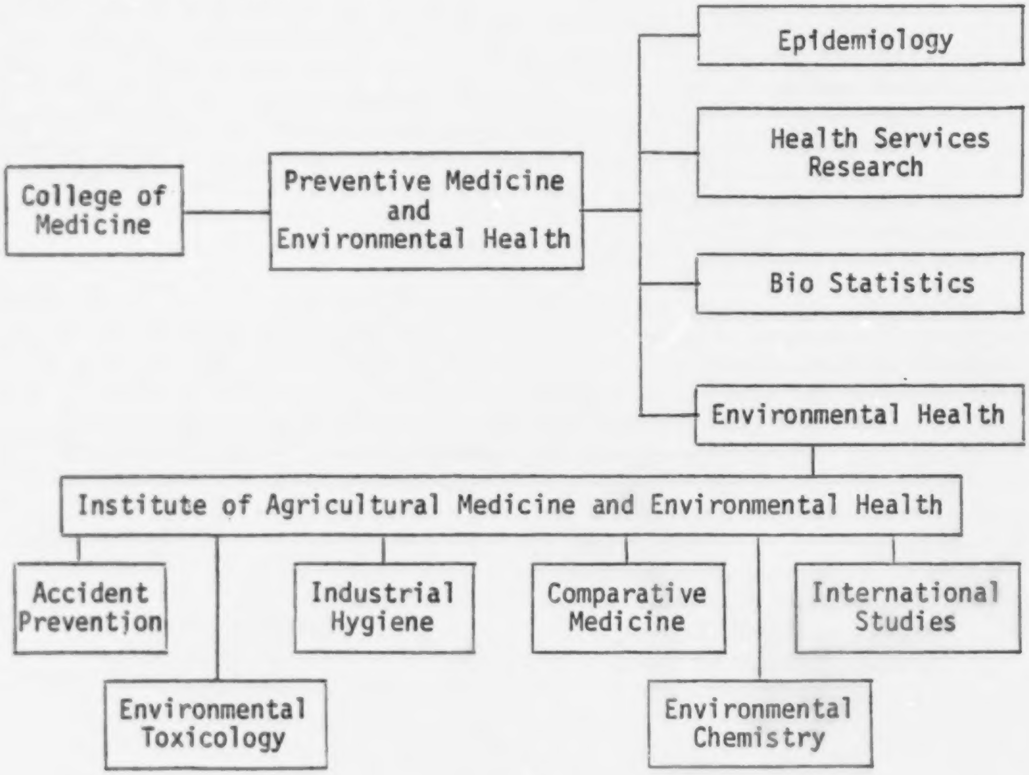
DEGREE: Doctor of Preventive Medicine and Environmental Health

CONTACT: Dr. Keith R. Long
Dr. Donald P. Morgan
Oakdale Campus
University of Iowa
Iowa City, Iowa 52242
(319) 353-4872

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

A schematic drawing of the relationship between the Institute of Agricultural Medicine and Environmental Health, the Department of Preventive Medicine and Environmental Health, and the College of Medicine follows:


College of Medicine
Preventive Medicine and Environmental Health
Epidemiology
Health Services Research
Bio Statistics
Environmental Health
Institute of Agricultural Medicine and Environmental Health
Accident Prevention
Environmental Toxicology
Industrial Hygiene
Comparative Medicine
Environmental Chemistry
International Studies

The toxicology program began in 1970 and is interdisciplinary in nature. It is offered through the Department of Preventive Medicine and Environmental Health, one of 27 departments under the College of Medicine.

The Institute of Agricultural Medicine and Environmental Health, established in 1955, was the first institute in the Western Hemisphere dedicated to the study of occupational health problems of the agricultural worker. In 1975 the Institute founded a unique Rural Health Program that promotes understanding of occupational and environmental health problems peculiar to rural populations.

The Institute provides a broad basis for interdisciplinary studies with other departments and colleges on campus including the College of Dentistry, Department of Fix Prosthodontics; College of Liberal Arts, Department of Chemistry; College of Engineering, Division of Energy Engineering and the College of Medicine, Departments of Biochemistry, Family Practice, Medicine and Neurology. Cooperative research and teaching activities have been established with the College of Veterinary Medicine, College of Agriculture and Division of Extension at Iowa State University. A joint program is also in effect with the National Animal Disease Center, Ames, Iowa.

PROGRAM REQUIREMENTS

Applicants should hold a bachelor's degree with a broad background in one of the biological, chemical, mathematical, or physical sciences or a professional degree in one of the health disciplines or in engineering. Grade-point averages must be at least 3.0 for admission to the Ph.D. program. The sum of the verbal and quantitative Graduate Record Examination scores must be 1050 or higher. Ph.D. students must complete a minimum of 70 semester hours.

CURRENT FACULTY, STUDENTS, GRADUATES

The University of Iowa is one of the three Epidemiologic Study Centers on pesticides. The project is also carried out at nine additional sites through the United States. Monies were divided between the state health departments and universities.

The activities of the Environmental Toxicology Section have been primarily concerned with pesticide studies including development of methodologies for pesticide residues in mammalian body tissue and excreta, the relationship between pesticide intake and urinary excretion of pesticide metabolities, estimation of personal absorption of pesticides during occupational exposures, development of an identification system as an aid to physicians in clinical management of pesticide poisoning cases, testing the effectiveness of absorbents and oils in the management of pesticide ingestion, and the completion of a manual for physicians on the management and treatment of pesticide poisonings.

Additional research has been conducted in cooperation with the Food and Drug Administration, Michigan State Health Department, EPA, National Cancer Institute, Consumer Protection Agency, U.S. Department of Agriculture, Center for Disease Control.

Three students are Ph.D. candidates in toxicology and graduates are one every other year. Employment is usually in middle management positions. Faculty number four. The total enrollment for the Environmental Health Program is eight M.S. and eight Ph.D. students.

Several tuition scholarships, fellowships in cancer epidemiology, and research assistantships are available.

PROGRAM PROJECTIONS

Since the University of Iowa has no undergraduate program, a small staff and no ready source of support, the growth of this program is seen as being stable. Most students come with their masters and pursue a Ph.D.

COURSE DESCRIPTION (a partial listing)

63:102 Health Science II: Man and the environment - A course dealing with human ecology in relation to the potential and demonstrable effects of the biological, chemical, physical and sociological factors of the environment on health and life. Special recognition is given to food and waterborne diseases, chemical contaminants of the environment, including pesticides, water and air pollutants, diseases of animals transmitted to man and the effects of population and urban and regional planning on health and disease. (3 s.h.)

63:103 Environmental Health Administration - Programs of governmental and voluntary agencies directed at evaluation of environmental health problems and at planning for and delivering environmental health services. The promotional and regulatory activities employed in environmental management and the legal basis for such activities. (2 s.h.)

63:109 Community Health - Introduction to epidemiology, clinical preventive medicine, organization and delivery of health services, environmental health and public health for sophomore medical students. Emphasis is on application of community and population skills to disease control and clinical problems. (2 s.h.)

63:133 Public Health Aspects of Food and Housing - Health aspects of food production and services, including laboratory and field training. Fundamentals of building and housing codes, their administration and enforcement. Environmental health problems

63:133 (Cont'd) - peculiar to residential and institutional establishments. (s.h. arr.)

63:191 Occupational Health - Introduction to the principles and practice of occupational health, industrial hygiene and safety, occupational health problems and their management. (3 s.h.)

63:209 Rural Health - A study of the rural and agricultural environment which result in specific health problems of rural residents and agricultural workers. A clinical orientation is maintained so that the material will be of practical value to the primary care physician and other health care personnel. Agricultural accidents, rural/agricultural toxicity problems and zoonotic diseases will be stressed. (3 s.h.)

63:240 Public Health Protozoology, Helminthology and Entomology - Biological and environmental problems associated with the epidemiology of parasitic diseases caused by protozoa, helminths, and arthropods. Primary emphasis is placed on the life history of parasites, their health modifying potential and the means of prevention. (s.h. arr.)

63:252 Theories of Environmental Policy - Major environmental concerns to human health and the basis upon which governmental legislation has been created, enacted or proposed to deal with them will be covered. Emphasis will be placed on the data on whcih such policies are formulated. (3 s.h.)

63:253 Zoonoses - A study of those infectious diseases common to animals and man. The diseases will be studied utilizing the modality of disease concept. The diseases will be discussed under the following environmental relationships: 1) zoonoses of the rural environment, 2) zoonoses of the urban environment, 3) zoonoses of occupational significance to agricultural workers, 4) zoonoses in foreign countries. Epidemiology, diagnosis, prevention and control will be considered for each disease. (3 s.h.)

63:260 Environmental Toxicology - The sources, routes of absorption and effects of environmental toxicants affecting man. Pathophysiology of toxicant actions, including those of metals, pesticides, solvents, other industrial chemicals. (3 s.h.)

63:263 Environmental Health Technology - A course designed to provide students with an understanding of environmental health laboratory function, its role in decision-making, quality assurance programs and how they operate, laboratory instrumentation characteristics, reliability of results and application to solution of environmental health problems. (2 s.h.)

INSTITUTION: MICHIGAN STATE UNIVERSITY

PROGRAM: Pesticide Research Center (PRC)

DEPARTMENT: (interdisciplinary research center)

DEGREE:

CONTACT: Dr. Matthew J. Zabik, Associate Director
Pesticide Research Center
Michigan State University
East Lansing, Michigan 48824
(517) 353-6376

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

According to a Center publication, the Pesticide Research Center at Michigan State University (MSU) is based on the "premise--and the promise--that research, particularly interdisciplinary research, will provide solutions." The Center, with facilities completed and occupied in 1970, has drawn from a variety of funding sources at various times during its development including the Environmental Protection Agency, National Institute of Health, former Food and Drug Administration, Michigan Agricultural Experiment Station located at MSU, U.S. Department of Agriculture, National Science Foundation, Michigan Legislature, Rockefeller Foundation, industry, and the university.

The Pesticide Research Center provides consultation services and analytical support in pesticides work to the various departments at MSU and to government departments in Michigan and neighboring states as well as to farmers who bring their pesticide problems to the university's Cooperative Extension Service. The PRC is one of four USDA "leader laboratories" in the United States charged with studying agricultural chemicals which do not appear to be profitable to commercial concerns but which are important to farmers regionally.

Facilities include an Analytical Laboratory with the latest in ultraprecise, ultrasensitive instruments needed to detect the chemical reactions that are critical to quality pesticide research. Among other instruments, the PRC houses a gas chromatograph and a mass spectrophotometer which are linked together and partially automated by a fast, accurate computer specifically designed for chemical analysis applications. The Electron Optics

Laboratory boasts two scanning electron microscopes, a transmission electron microscope, and an electron microprobe; this equipment is used by researchers in various university departments and colleges (e.g., examination of microbes related to sewage treatment by the Institute of Water Research). The PRC's facilities include a 6,000 square foot controlled environment room; 18,000 square feet of conventional greenhouses; three rearing rooms for animals and insects and three cold rooms for preserving biological materials; and a ventilation system providing 100 percent air exchange.

Research projects currently underway at the Center include: the movement and fate of pesticides in the environment, side-effects arising from the biological magnification of organochlorines in Lake Michigan, mode of action of herbicides, insecticide-resistant predators for orchard pest control, juvenile-hormone insecticides, systematic fungicides, alternative methods of pest control, and transmission of plant viruses by aphids.

CURRENT FACULTY, STUDENTS, GRADUATES

The PRC provides facilities for sixteen researchers from five departments in the Colleges of Agriculture and Natural Sciences. Twenty to thirty graduate students are currently involved in research projects at the Center. Of the ten or so students whose research work is affiliated with the PRC and who complete a given graduate degree program in a given year, most M.S. candidates pursue the Ph.D. and most do so at Michigan State. Upon finishing their academic training, most of the PRC graduate student researchers are employed in the private sector; but a few, particularly in entomology and toxicology, work in state and federal laboratories.

As noted in the current MSU catalog, "Lecture-laboratory courses are given in the Center on subjects such as weed control, pesticide analysis, plant research procedures, electron microscopy, insect physiology and toxicology to about 140 graduate students each year." All of the principle investigators at the PRC are also faculty members in various departments. Undergraduates and graduate students, though enrolled officially in other programs in the university, conduct pesticides research at the Center. There are also postdoctoral fellows in residence at the PRC. The Center provides excellent training opportunities for students wishing to enter the field of "basic and applied research on pesticides, their fate in the environment, and their role in pest control."

PROGRAM PROJECTIONS

The Pesticide Research Center is attempting to establish an interdisciplinary graduate curriculum that will allow students more flexibility in designing a course of study than currently permitted given existing departmental requirements that students must follow. The ideal core staff for this program would consist of four faculty members with expertise in metabolism, toxicology, chemistry, and the environment. Plant sciences and environmental toxicology are key areas to consider in developing a worthwhile training program at this level.

INSTITUTION: UNIVERSITY OF MIAMI SCHOOL OF MEDICINE

PROGRAM: Pesticide Protection

DEPARTMENT: Epidemiology and Public Health
DEGREE: Certificate of Completion

CONTACT: Ms. Erica Koehler, R.N., M.P.H.
Community Health Administrator
University of Miami School of Medicine
Department of Epidemiology and Public Health
P.O. Box 520875
Miami, Florida 33152
(305) 547-6417

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The University of Miami School of Medicine has recently completed a three-year pilot training project on pesticide protection, under the sponsorship of the U.S. Environmental Protection Agency. Under the direction of Dr. John E. Davies, chairman of the Department of Epidemiology and Public Health, health professionals in emergency rooms, health clinics, governmental agencies, and other health-related organizations received training in recognizing, managing, preventing, and verifying cases of pesticide poisoning.

During the grant period, twenty-two training sessions were held throughout the country; the first session was held in May, 1976. Five of the sessions, "train the trainer" courses, were designed to teach professionals to train others in pesticide protection. Site locations were chosen partially by request, and partially with consideration of geography; attempts were made to scatter the sessions throughout the country. To continue the spread of this knowledge following the training grant's completion, an educational package was developed and has been made available for sale. Each package contains instructional cassette tapes, slides, a training manual, pre- and post-tests, and a variety of handouts.

Several forms of research are carried out within the department that relate to pesticide poisonings, their detection, prevention, and treatment. A current area of research relates to the effects of fabric sprays on dermal absorption of pesticides. Additionally, persons participating in the pesticide protection training were given kits for performing recommended analyses. These persons in turn report to the department on uses made of the tests, and test results. Basic and applied research within and outside of the department have formed the basis for the pesticide protection training manual.

PROGRAM REQUIREMENTS

The training sessions and education kit deal mainly with two major types of pesticide illness: severe and mild acute systemic poisoning, and topical effects of the eyes and skin. All training sessions lasted two days, except "train the trainer" courses, which lasted three days each. All participants successfully completing the courses were given a certificate of completion. In addition, physicians received ten credits in category one from the American Medical Association's Physician Recognition Award program. In Florida and several other states, nurses completing the program received one continuation unit from the State Nursing Association. Under the initial grant, there was no charge to participants in official health-related agencies. Only those attending from private industry were charged tuition.

CURRENT FACULTY, STUDENTS, GRADUATES

Since the completion of the training grant, no pesticide protection training sessions have been held. During the program implementation period, two persons of the Department of Epidemiology and Public Health conducted the training sessions. A total of seven hundred and ninety persons participated in the first nineteen courses, with approximately eight hundred and fifty participating totally. Data from the first twelve sessions indicate that thirty-four percent of the trainees were family health, public health, and clinic nurses. This figure includes both registered nurses and licensed practical nurses (one hundred and thirty-five, and thirty-one respectively).

An additional sixty-four physicians and two veterinarians attended these sessions, as well as sixteen emergency medical technicians. The remaining fifty percent of the participants included hospital and clinic administrators, and scientists and laboratory technicians of chemical companies. A large portion of the trainees represented migrant health clinics; migrant workers are especially susceptible to pesticide exposure and resultant poisonings.

A participant evaluation sheet was completed by each participant following the training, to evaluate the effectiveness of the courses. Trainees were asked to rate as "very good", "acceptable", "lacking", or "poor" a number of variables under the following general topics: subject matter, methods of presentation, reference materials, meeting room, quality of slides, quality of films, and coffee breaks. Ninety-eight percent of the responses were in positive categories ("very good" and "acceptable"). Of the positive responses, seventy-five percent were in the "very good" category.

PROGRAM PROJECTIONS

Program administrators have requested a grant extension to provide for ten additional training sessions. It appears, however, that continuation funding is not available. If the grant is not extended, no more training sessions will be held.

A limited number of educational packages will be available for purchase. However, the cost factor inhibits widespread use of the kit. Additionally, while continual updates would be made of the training program based upon participant evaluations and research results, modifications of the educational package cannot be made without the required funding.

Researchers and community health personnel in the Department of Epidemiology and Public Health continue to see first-hand the adverse effects of pesticides on agricultural workers, especially migrants. Follow-up data on training sessions have confirmed the utility of the courses in assisting in the detection, treatment, and prevention of pesticide illnesses. Numerous agencies, hospitals, and clinics have requested follow-up training because of the high personnel turnover rates. Concern has been generated that research discoveries will not be translated into practical benefits unless avenues for information dissemination are continually utilized.

COURSE DESCRIPTION

According to the program's brochure, topics covered in the training sessions and the educational package include the following:

Recognition

- Toxicological characteristics of organophosphates, carbamates, organochlorines, nitro and chloro phenols, and other widely used pesticide groups.
- Physiological reactions to exposure to various pesticides.
- Types of pesticide exposure that can lead to poisoning, including concentrations, methods of intake, and routes of absorption.
- Internal and external symptoms of kinds of pesticide poisoning, from mild to severe exposure or intake.
- Suggested clinical and laboratory diagnoses to verify different varieties of poisoning.

Prevention

- Review of epidemiological data on incidence of various kinds of pesticide exposure.
- Suggested guidelines for clothing and equipment of field workers with frequent contact with pesticides.
- Hygenic do's and don'ts on pesticide handling.
- Understanding labels on pesticide containers.

Treatment

- Antidotal and other emergency therapies.
- Special treatment procedures for infants and children.
- Decontamination procedures.

INSTITUTION: UNIVERSITY OF MID-AMERICA (UMA)

PROGRAM: Pests, Pesticides, and Pesticide Safety (short course)

DEPARTMENT:

DEGREE: no credits or degrees awarded except through member institutions.

CONTACT: Mr. Milan Wall
Office of Marketing
P.O. Box 82006
University of Mid-America
Lincoln, Nebraska 68501
(402) 467-3671

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The University of Mid-America (UMA) is a consortium of midwestern state universities (Iowa, Kansas, Minnesota, Missouri, Nebraska, and South Dakota) with the purpose of developing, producing, and distributing college-level materials for distance teaching and open learning. UMA courses are designed as integrated multimedia packages combining television, print, newspaper, and audio components in a manner that makes them more accessible to at-home learners. These courses are also made available for lease by colleges and universities across the nation. The primary audience for such courses typically includes adults who have some college experience and whose family or job responsibilities make it difficult for them to continue their education on campus.

Funding for UMA comes from the National Institute of Education (65-70 percent) and from private foundations (30-35 percent). Courses and development spending are discussed with an academic council composed of two academic/administrative people from each member university. After the decision to develop a particular course is made, a team of experts with competencies in course design, evaluation, content, media production, and marketing put together the educational package. The UMA academic council and curriculum committee have decidedon five areas of concentration: humanities, agriculture, energy and environment, business, and continuing professional education (health, nutrition, small business mangement).

A short course "Pests, Pesticides, and Safety for the Private Applicators" produced by UMA was designed primarily in response to federal regulations requiring training of private applicators and handlers of restricted-use pesticides. The multimedia nature of the course (five videotapes, workbook, instructor's manual, and the EPA manual) makes it ideal as a supplement to state certification training programs or as the basic training vehicle itself. According to UMA officials, The EPA has reviewd the course materials and determined that they satisfy federal requirements for certifying private applicators of restricted-use pesticides.

A substantial portion of UMA's budget goes to research--what works and what does not. For example, in testing the effectiveness of the pesticides series, a group of 20 Nebraska farmers screened the video and print materials developed for training private pesticide applicators and assessed informational and asthetic components of these curriculum materials.

PROGRAM REQUIREMENTS

Because the University of Mid-America does not award any degrees or grant any credits for enrollment in and completion of its courses of study, there are no specified program requirements. Any course requirements are established by the member institution through which the student enrolls for a UMA course.

CURRENT FACULTY, STUDENTS, GRADUATES

Since its regional inception in 1974, over 6,000 people have enrolled in credit and non-credit courses produced by UMA. Recruitment of students depends on each state's delivery system and the type of course offered. Newspaper ads are usually the most effective means of attracting students; but posters, mass media, selected mailings (churches, teachers, etc.), and state fair booths are also employed. Students have access to a toll-free phone line to faculty, learning resource centers with audio-visual equipment and adult education counselors, and even newspaper articles that present course materials. UMA regularly conducts surveys of types of people enrolled in its courses, their cognitive and affective orientations to the classes, and their reasons for enrolling in a particular course.

PROGRAM PROJECTIONS

The university's long-range plan is to become administratively self-supporting although monies for course development would continue to be generated from outside agencies. Continuing concerns of the UMA staff are to be able to develop quality course materials, to build an inventory of courses, to maintain funding, and to attract qualified personnel.

COURSE DESCRIPTION

Unit I The Environment and Pesticides - This unit investigates some of the problems encountered by growers, producers, and ranchers as they do their work. Pest management plans are discussed and alternative pest control techniques are explained.

Unit II Pests - Unit presents information on the different types of pests, their characteristics, and how they can be controlled. The major goal of this unit is to provide some basic information on pests so that the viewer can begin to properly identify the pest and select an appropriate control method.

Unit III Pesticides - This unit discusses the various types of pesticides, how they work, how to apply them, and how to select an appropriate pesticide. Different types of formulations are discussed with an emphasis on the mixing and application of each. The last topic in the unit discusses the hazards and toxicity of the various formulations.

Unit IV Safety - In this unit, some of the safety precautions that can be used in preventing accidents when working with pesticides are discussed. Emphasis is given to safety clothing that should be worn during the mixing and application of pesticides and to the clean-up and disposal of containers. Two brief computational examples of calibration--one for dry and one for liquid pesticides--are also included. The program discusses the symptoms and first-aid techniques for pesticide poisoning.

Unit V Laws and Labels - Unit discusses the reasons for and the implications of the Federal Insecticide, Fungicide, and Rodenticide Act. The student receives information on how to comply with the Federal Drug and Cosmetic Act, an act that describes the amount of pesticide residue that can legally remain on or in a harvested product.

Photo reprinted from the Michigan Technological University Catalog 1975-76

APPENDICES

Photo reprinted from the University of Illinois Institute of Technology Booklet

Photo reprinted from the Indiana University of Public and Environmental Affairs Catalog 1977-78

I

APPENDIX I

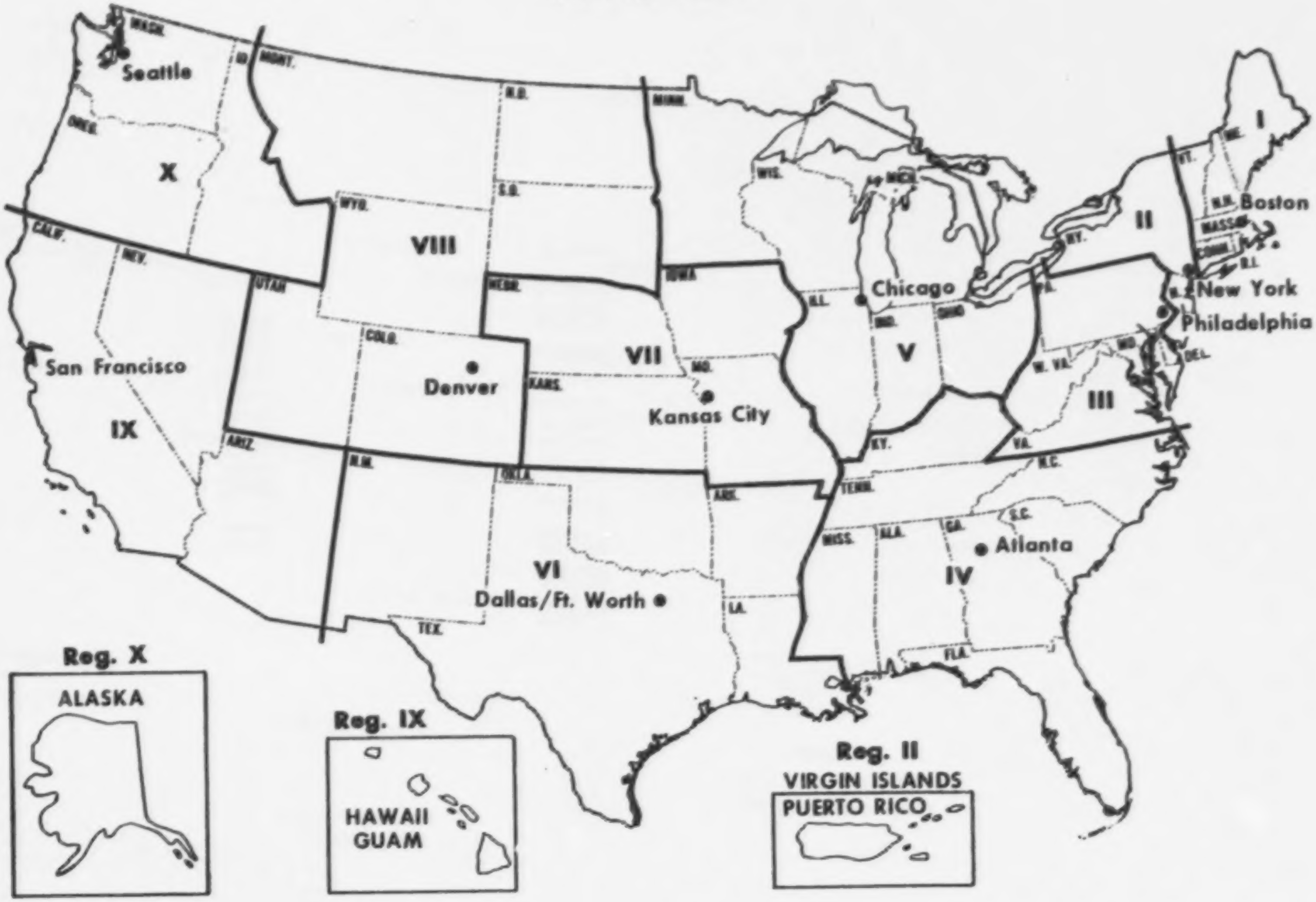
Degree Abbreviations

A.A.	Associate of Arts
A.A.Ag.	Associate of (in) Applied Agriculture
A.Ag.	Associate of (in) Agriculture
A.A.P.C.T.	Associate Degree in Air Pollution Control Technology
A.A.S.	Associate of Applied Science
A.B.	Bachelor of Arts
A.D.	Associate Degree
A.E.T.	Associate in Engineering Technology
A.M.T.	Associate of Mining Technology
A.N.E.T.	Associate of Nuclear Engineering Technology
A.S.	Associate in Science
A.S.E.M.T.	Associate of Science in Engineering Mining Technology
A.T.	Associate of Technology
B.A.	Bachelor of Arts
B.E.M.T.	Bachelor of Engineering in Mining Technology
B.S.	Bachelor of Science
B.S. (N.E.)	Bachelor of Science in Nuclear Engineering
B.S. (N.E.S.)	Bachelor of Science (Nuclear Engineering Sciences)
B.S. (N.R.)	Bachelor of Science in Natural Resources
B.S.A.	Bachelor of Science in Agriculture
B.S.C.E.	Bachelor of Science in Civil Engineering
B.S.Ch.E.	Bachelor of Science in Chemical Engineering
B.S.E.	Bachelor of Science in Engineering
B.S.E.H.	Bachelor of Science in Environmental Health
B.S.E. (N.E.)	Bachelor of Science (Nuclear Engineering)
B.S.E.S.	Bachelor of Science in Engineering Sciences
B.S.N.E.	Bachelor of Science in Nuclear Engineering
B.T.	Bachelor of Technology
Cert.	Certificate

D.E.	Doctor of Engineering
D.P.H.	Doctor of Public Health
D.S.	Doctor of Science
D.S. (Hyg.)	Doctor of Science Hygiene
D.Sc.	Doctor of Science
Dr.P.H.	Doctor of Public Health
E.E.	Environmental Engineer
Eng.	Engineer
Engr.	Engineer
Engr.Sc.D.	Doctor of Engineering Science
Env.E.	Environmental Engineer
Envir.Eng.	Environmental Engineer
M.A.	Master of Arts
M.Ag.	Master of Agriculture
M.Agr.	Master of Agriculture
M.A.S.	Master of Applied Science
M.C.E.	Master of Civil Engineering
M.E.	Master of Engineering
M.E.E.E.	Master of Engineering in Environmental Engineering
M.E.A.S.	Master of Environmental Arts and Science
M.E.H.S.	Master of Environmental Health Sciences
M.E.M.	Master of Environmental Management
M.E.P.C.	Master in Environmental Pollution Control
M.Eng.	Master of Engineering
M.Engr.	Master of Engineering
M.F.	Master of Forestry
M.M.E.	Master of Mechanical Engineering
M.P.	Master of Philosophy
M.P.A.	Master of Public Affairs
M.P.H.	Master of Public Health
M.P.P.P.M.	Master of Plant Protection and Pest Management

M.P.S.	Master of Professional Studies
M.S.	Master of Science
M.S. (Hyg.)	Master of Science Hygiene
M.S.C.E.	Master of Science in Civil Engineering
M.S.Ch.E.	Master of Science in Chemical Engineering
M.S.E.	Master of Science in Engineering
M.S.E.E.	Master of Science in Environmental Engineering
M.S.En.E.	Master of Science in Environmental Engineering
M.S.Eng. S.	Master of Science in Environmental Engineering
M.S.Eng. Sci.	Master of Science in Engineering Science
M.S.E.H.	Master of Science in Environmental Health
M.S.E.M.P.	Master of Science in Energy Management and Policy
M.S.E.S.	Master of Science in Environmental Science (Studies)
M.S.P.H.	Master of Science in Public Health
M.S.(S.E.)	Master of Science in Sanitary Engineering
M.S.(S.S.)	Master of Science in Sanitary Science
N.E.	Nuclear Engineering
Nuc. Eng.	Nuclear Engineering
Ph.D.	Doctor of Philosophy
S.B.	Bachelor of Science
Sc.D.	Doctor of Science
S.M.	Master of Science

STANDARD REGIONAL BOUNDARIES
TEN REGIONS


WASH.
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S.D.
COLO.
Denver
N.M.
NEBR.
KANS.
VII
MINN.
IOWA
MO.
Kansas City
OKLA.
TEX.
VI
Dallas/Ft. Worth
ARK.
LA.
WIS.
ILL.
MICH.
IND.
OHIO
Chicago
V
KY.
TENN.
MISS.
ALA.
GA.
S.C.
N.C.
FLA.
Atlanta
IV
PA.
W. VA.
VA.
MD.
DEL.
III
Philadelphia
N.Y.
N.J.
New York
II
ME.
VT.
N.H.
MASS.
CONN.
R.I.
Boston
I
Reg. X
ALASKA
Reg. IX
HAWAII
GUAM
Reg. II
VIRGIN ISLANDS
PUERTO RICO

TERMINOLOGY

ACT (American College Testing) and SAT (Scholastic Aptitude Test) - Standardized examinations which are intended to provide applicants and institutions with a numerical statement of an individual's ability and readiness to successfully complete college/university level work.

Co-op program - A plan whereby a student receives financial assistance and academic credit under the direction of a cooperating employment site representative and a faculty advisor in exchange for an agreed upon condition of employment. Students must complete all degree requirements as per the norm.

Course - For the purpose of this study, a course is considered a unit of a program, in which a body of knowledge is presented, the satisfactory completion of which leads to the awarding of a predetermined or individually arranged number of credits.

ECPD (Engineers' Council for Professional Development) - Accrediting body for programs in engineering technology.

ERIC (Educational Resources Information Center) - A national information system designed and developed by the U.S. Office of Education, and now supported and operated by the National Institute of Education (NIE), for providing ready access to descriptions of exemplary programs, research and development efforts, and related information that can be used in developing more effective educational programs.

GRE (Graduate Record Examination) - (General Aptitude) An examination of verbal and mathematical competency and aptitude, which is designed to provide a numerical indication of an individual's ability to successfully complete advanced level work. For the purposes of the study, the GRE will not refer to the Advanced Examinations.

Internship/Applied Study Term - An arrangement which is intended to provide a simulation of work experience under the direction of academic advisors and is designed to be an integral segment of an individual's academic program. (College credit may be given.)

IRIS (Instructional Resources Information System) - A computerized information base listing materials relating to education and training in the water quality control field, which is located in the National Training and Operational Technology Center of the U.S. Environmental Protection Agency.

MEDLINE - Computerized literature search services with application to medical information.

NTIS (National Technical Information Service) - Computerized literature search services.

Program - For the purpose of this study, a plan of study, either completely prescribed, or containing options, with an identity of its own, and standard rules and procedures, the satisfaction of which may lead to a degree, certificate, or diploma.

Quarter hours - vs. - Semester hours - One semester hour is the credit equivalent to one and a half quarter hours.

Standard Federal Boundaries - Geographic division of the United States for the purposes of decentralized administration; in this report also referred to as EPA regions (see map on preceding page).

TOXLINE - Computerized literature search services with particular application to the recall of information concerning toxic substances.

WRSIC (Water Resources Scientific Information Center) - Collects, screens, organizes and disseminates reports in water resources.

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APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
AIR	Carnegie-Mellon University	Pittsburgh, PA
	Clemson University	Clemson, SC
	Drexel University	Philadelphia, PA
	George Washington University-NASA	Hampton, VA
	Harvard University School of Public Health	Boston, MA
	Hudson Valley Community College	Troy, NY
	Massachusetts Institute of Technology	Ithaca, NY
	Michigan Technological University	Houghton, MI
	Middlesex County College	Edison, NJ
	Muskingum Area Technical College	Zanesville, OH
	New Jersey Institute of Technology	Newark, NJ
	North Carolina State University	Chapel Hill, NC
	North Dakota State School of Science	Wahpeton, ND
	Northeastern University	Boston, MA
	Ohio State University	Columbus, OH
	Portland State University	Portland, OR
	Prairie State Community College	Chicago Heights, IL
	Purdue University	West Layfayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rutgers-The State University of New Jersey	New Brunswick, NJ
	Springfield Technical Community College	Springfield, MA
	Stevens Institute of Technology	Hoboken, NJ
	Sumter University	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	The Pennsylvania State University	University Park, PA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Florida	Gainesville, FL
	University of Iowa	Iowa City, IA
	University of Kentucky	Lexington, KY
	University of Maryland	College Park, MD
	University of Michigan	Ann Arbor, MI
	University of Missouri-Rolla	Rolla, MO
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Texas-Austin	Austin, TX
	University of Washington	Seattle, WA
	University of Wisconsin-Milwaukee	Milwaukee, WI
	Vanderbilt University	Nashville, TN
	Washington State University	Pullman, WA
	Washington University	St. Louis, MO
	West Virginia University	Morgantown, WV
	Yale University	New Haven, CT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE:	Antioch College	Yellow Springs, OH
	Baylor University	Waco, TX
	Bemidji State University	Bemidji, MN
	California Institute of Technology	Pasadena, CA
	California Polytechnic State University	San Luis Obispo, CA
	Catholic University of America	Washington, DC
	Carnegie-Mellon University	Pittsburgh, PA
	Chattanooga State Technical Community College	Chattanooga, TN
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Cornell University	Ithaca, NY
	Delaware Technical and Community College	Newark, DE
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	Duke University	Durham, NC
	East Central Oklahoma State University	Ada, OK
	East Tennessee State University	Johnson City, TN
	Evergreen State College	Olympia, WA
	Ferris State College	Big Rapids, MI
	Florida International University	Miami, FL
	Georgia Institute of Technology	Atlanta, GA
	Heed University	Hollywood, FL
	Hocking Technical College	Nelsonville, OH
	Howard University	Washington, DC
	Hunter College	New York, NY
	Indiana University	Bloomington, IN
	Iowa State University	Ames, IA
	Johns Hopkins University	Baltimore, MD
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Lamar University	Beaumont, TX
	Macalester College	St. Paul, MN
	Massachusetts Institute of Technology	Cambridge, MA
	McNeese State University	Lake Charles, LA
	Miami University	Oxford, OH
	Michigan State University	East Lansing, MI
	Middle Tennessee State University	Murfreesboro, TN
	Morehead State University	Morehead, KY
	Muskingum Area Technical College	Zanesville, OH
	New Jersey Institute of Technology	Newark, NJ
	North Carolina State University	Raleigh, NC
	Northland College	Ashland, WI
	Ohio State University	Columbus, OH

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PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
MPOSITE: ont'd)	Ohio University	Athens, OH
	Oscar Rose Junior College	Midwest City, OK
	OSU Oklahoma City Technical Institute	Oklahoma City, OK
	Polytechnical Institute of New York	Brooklyn, NY
	Princeton University	Princeton, NJ
	Purdue University	West Lafayette, IN
	Raymond Walters General and Technical College (University of Cincinnati	Cincinnati, OH
	Rensselaer Polytechnical Institute	Troy, NY
	Rutgers University	New Brunswick, NJ
	Sam Houston State University	Huntsville, TX
	Sangamon State University	Springfield, IL
	Slippery Rock State College	Slippery Rock, PA
	Springfield Technical and Community College	Springfield, MA
	Stevens Institute of Technology	Hoboken, NJ
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas A & M University	College Station, TX
	The Cooper Union	New York, NY
	The Pennsylvania State University	University Park, PA
	University of Alabama	University, AL
	University of Alaska	Fairbanks, AK
	University of Arkansas	Fayetteville, AR
	University of California-Santa Barbara	Santa Barbara, CA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Florida	Gainesville, FL
	University of Georgia	Athens, GA
	University of Kansas	Lawrence, KS
	University of Louisville	Louisville, KY
	University of Maine-Orono	Orono, Maine
	University of Michigan	Ann Arbor, MI
	University of Minnesota	Minneapolis, MN
	University of North Carolina	Chapel Hill, NC
	University of Oklahoma	Norman, OK
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Toledo	Toledo, OH
	University of Utah	Salt Lake City, UT
	University of Washington	Seattle, WA
	University of Wisconsin-Green Bay	Green Bay, WI
	University of Wisconsin-Madison	Madison, WI
	Utah State University	Logan, UT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE: (Cont'd)	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Washington State University	Pullman, WA
	Western Kentucky University	Bowling Green, KY
	Western Washington University (Huxley College of Environmental Studies)	Bellingham, WA
	West Virginia University	Morgantown, WV
	Yale University	New Haven, CT
ENERGY:	Bluefield State College	Bluefield, WV
	Brigham Young University	Provo, UT
	Carnegie-Mellon University	Pittsburgh, PA
	Columbia University	New York, NY
	Cornell University	New York, NY
	Georgia Institute of Technology	Atlanta, GA
	Hartford State Technical College	Hartford, CT
	Kansas State University	Manhattan, KS
	Lamar University	Beaumont, TX
	Massachusetts Institute of Technology	Cambridge, MA
	Morehead State University	Morehead, KY
	Muskingum Area Technical College	Zanesville, OH
	Oregon State University	Corvallis, OR
	Pikeville College	Pikeville, KY
	Polytechnic Institute of New York	Brooklyn, NY
	Princeton University	Princeton, NJ
	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Southern Technical Institute	Marietta, GA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Kentucky	Lexington, KY
	University of New Mexico	Albuquerque, NM
	University of Pennsylvania	Philadelphia, PA
	University of Tennessee	Knoxville, TN
	West Virginia Institute of Technology	Montgomery, WV
	West Virginia University	Morgantown, WV

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
ISE:	George Washington University-NASA	Hampton, VA
	Georgia Institute of Technology	Altanta, GA
	Massachusetts Institute of Technology	Cambridge, MA
	Memphis State University	Memphis, TN
	North Carolina State University	Raleigh, NC
	The Pennsylvania State University	University Park, PA
	University of Cincinnati	Cincinnati, OH
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Tennessee Center for Health Sciences	Memphis, TN
STICIDES:	Abraham Baldwin Agricultural College	Tifton, GA
	Broward Community College	Ft. Lauderdale, FL
	Central Technical Community College	Hastings, NE
	Delgado Community College	New Orleans, LA
	Harvard University School of Public Health	Boston, MA
	Mississippi State University	Mississippi State, MS
	New Mexico State University	Las Cruces, NM
	North Carolina State University	Raleigh, NC
	Ohio State University	Columbus, OH
	Oregon State University	Corvallis, OR
	Rutgers State University of New Jersey	New Brunswick, NJ
	State University of New York at Farmingdale	Farmingdale, NY
	Texas A & M University	College Station, TX
	The Pennsylvania State University	University Park, PA
	University of California-Berkeley	Berkeley, CA
	University of California-Davis	Davis, CA
	University of California-Riverside	Riverside, CA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Georgia	Athens, GA
	University of Iowa	Iowa City, IA
	University of Maryland	College Park, MD
	University of New Hampshire	Durham, NH
	University of Pittsburgh	Pittsburgh, PA
	University of Rochester	Rochester, NY
	Utah State University	Logan, UT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
POTABLE WATER:	Atlanta University Center/Georgia Institute of Technology	Atlanta, GA
	Brigham Young University	Provo, UT
	California State University	Sacramento, CA
	Carnegie-Mellon University	Pittsburgh, PA
	Casper College	Casper, WY
	Central Technical Community College	Hastings, NE
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Colorado State University	Fort Collins, CO
	Community College of Denver-Red Rocks	Golden, CO
	Cornell University	Ithaca, NY
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	East Maine Vocational Technical Institute	Bangor, ME
	Hudson Valley Community College	Troy, NY
	Illinois Institute of Technology	Chicago, IL
	Iowa State University	Ames, IA
	J. Sargeant Reynolds Community College	Richmond, VA
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Linn-Benton Community College	Albany, OR
	Manhattan College	New York, NY
	Marquette University	Milwaukee, WI
	Massachusetts Institute of Technology	Cambridge, MA
	Miami-Dade Community College	Miami, FL
	Michigan Technological University	Houghton, MI
	Middlesex Community College	Edison, NJ
	Missouri Southern State College	Joplin, MO
	Montana State University	Bozeman, MT
	Muskingum Area Technical College	Zanesville, OH
	Northeastern University	Boston, MA
	Northern Montana College	Havre, MT
	Ohio State University	Columbus, OH
	Operator Training Center	Murfreesboro, TN
	Oregon Institute of Technology	Klamath Falls, OR
	Oscar Rose Junior College	Midwest City, OK
	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rice University	Houston, TX
	Rochester Institute of Technology	Rochester, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	Southern Illinois University	Edwardsville, IL

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PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

ATEGORY	INSTITUTION	LOCATION
ABLE WATER: nt'd)	Springfield Technical Community College	Springfield, MA
	Stanford University	Stanford, CA
	State University of New York at Buffalo	Buffalo, NY
	Stevens Institute of Technology	Hoboken, NJ
	Sumter Technical Community College	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	The Pennsylvania State University/ Capitol Campus	Middletown, PA
	Tufts University	Boston, MA
	Ulster County Community College	Stone Ridge, NY
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Hawaii	Honolulu, HI
	University of Iowa	Iowa City, IA
	University of Kansas	Lawrence, KS
	University of Kentucky	Lexington, KY
	University of Maine at Orono	Orono, ME
	University of Michigan	Ann Arbor, MI
	University of Missouri-Columbia	Columbia, MO
	University of Missouri-Rolla	Rolla, MO
	University of Nebraska	Lincoln, NE
	University of North Carolina	Chapel Hill, NC
	University of Pennsylvania	Philadelphia, PA
	University of Pittsburgh	Pittsburgh, PA
	University of Rhode Island	Kingston, RI
	University of Tennessee	Knoxville, TN
	University of Texas-Austin	Austin, TX
	University of Wisconsin-Madison	Madison, WI
	University of Wyoming	Laramie, WY
	Utah State University	Logan, UT
	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Water and Wastewater Technical School	Neosho, MO
	West Georgia College	Carrollton, GA
	West Virginia University	Morgantown, WV
	Wytheville Community College	Wytheville, VA

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
RADIATION:	Central Florida Community College	Ocala, FL
	Chattanooga State Technical Community College	Chattanooga, TN
	Columbia University	New York, NY
	Cornell University	Ithaca, NY
	Hartford State Technical College	Hartford, CT
	Harvard University School of Public Health	Boston, MA
	Kansas State University	Manhattan, KS
	Massachusetts Institute of Technology	Cambridge, MA
	Memphis State University	Memphis, TN
	Missouri Southern State College	Joplin, MO
	Oak Ridge Associated Universities	Oak Ridge, TN
	Oklahoma State University	Stillwater, OK
	Rensselaer Polytechnic Institute	Troy, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	St. Louis Community College at Forest Park	St. Louis, MO
	Southern Technical Institute	Marietta, GA
	The Pennsylvania State University	University Park, PA
	University of Florida	Gainesville, FL
	University of Kansas	Lawrence, KS
	University of Lowell	Lowell, MA
	University of Maryland	College Park, MD
	University of Michigan	Ann Arbor, MI
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
SOLID WASTE:	Carnegie-Mellon University	Pittsburgh, PA
	Clarkson College	Potsdam, NY
	Cornell University	New York, NY
	Drexel University	Philadelphia, PA
	Hofstra University	Hempstead, NY
	Michigan Technological University	Houghton, MI
	Rensselaer Polytechnic Institute	Troy, NY
	Temple University	Philadelphia, PA
	The Pennsylvania State University	University Park, PA
	University of Iowa	Iowa City, IA
	University of Missouri-Rolla	Rolla, MO
	University of Pittsburgh	Pittsburgh, PA
	Vanderbilt University	Nashville, TN
	West Virginia University	Morgantown, WV
	Wilson County Technical Institute	Wilson, NC
	Yale University	New Haven, CT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

ATEGORY	INSTITUTION	LOCATION
STEWATER:	Atlanta University Center/ Georgia Institute of Technology	Atlanta, GA
	Brigham Young University	Provo, UT
	California State University-Sacramento	Sacramento, CA
	Carnegie-Mellon University	Pittsburgh, PA
	Casper College	Casper, WY
	Central Technical Community College	Hastings, NE
	Charles County Community College	La Plata, MD
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Colorado State University	Fort Collins, CO
	Community College of Denver-Red Rocks	Golden, CO
	Cornell University	Ithaca, NY
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	East Maine Vocational Technical Institute	Bangor, ME
	Greenville Technical College	Greenville, SC
	Harvard University	Cambridge, MA
	Hudson Valley Community College	Troy, NY
	Illinois Institute of Technology	Chicago, IL
	Iowa State University	Ames, IA
	J. Sargeant Reynolds Community College	Richmond, VA
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Linn-Benton Community College	Albany, OR
	Manhattan College	New York, NY
	Marquette Technical University	Milwaukee, WI
	Massachusetts Institute of Technology	Cambridge, MA
	Miami-Dade Community College	Miami, FL
	Michigan Technological University	Houghton, MI
	Middlesex County College	Edison, NJ
	Missouri Southern State College	Joplin, MO
	Montana State University	Bozeman, MT
	Muskingum Area Technical College	Zanesville, OH
	New England Regional Wastewater Institute	S. Portland, ME
	New Jersey Institute of Technology	Newark, NJ
	Northeastern University	Boston, MA
	Northern Montana College	Havre, MT
	Ohio State University	Columbus, OH
	Operator Training Center	Murfreesboro, TN
	Oregon Institute of Technology	Klamath Falls, OR
	Oscar Rose Junior College	Midwest City, OK

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
WASTEWATER: (Cont'd)	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rice University	Houston, TX
	Rochester University	Rochester, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	Southern Illinois University	Edwardsville, IL
	Springfield Technical and Community College	Springfield, MA
	Stanford University	Stanford, CA
	State Technical Institute at Memphis	Memphis, TN
	State University of New York-Buffalo	Buffalo, NY
	Stevens Institute of Technology	Hoboken, NJ
	Sumter Technical Community College	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	The Pennsylvania State University/ Capitol Campus	Middletown, PA
	Tufts University	Boston, MA
	Ulster County Community College	Stone Ridge, NY
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Hawaii	Honolulu HI
	University of Kansas	Lawrence, KS
	University of Kentucky	Lexington, KY
	University of Lowell	Lowell, MA
	University of Maine at Orono	Orono, ME
	University of Missouri-Columbia	Columbia, MO
	University of Missouri-Rolla	Rolla, MO
	University of Nebraska	Lincoln, NE
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Rhode Island	Kingston, RI
	University of Tennessee	Knoxville, TN
	University of Texas	Austin, TX
	University of Wisconsin-Madison	Madison, WI
	University of Wyoming	Laramie, WY
	Utah State University	Logan, UT
	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Water and Wastewater Technical School	Neosho, MO
	West Georgia College	Carrollton, GA
	West Virginia University	Morgantown, WV
	Wytheville Community College	Wytheville, VA

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
AL	Alabama A & M University	Huntsville
	Alabama Christian College	Montgomery
	Alabama Lutheran Junior College	Selma
	Alexander City State Junior College	Alexander City
	Athens State College	Athens
	Auburn University	Auburn
	Auburn University at Montgomery	Montgomery
	Birmingham-Southern College	Birmingham
	Brewer State Junior College	Fayette
	Enterprise State Junior College	Enterprise
	Faulkner State Junior College	Bay Minette
	Gadsden State Junior College	Gadsden
	George C. Wallace State Community College	Dothan
	George C. Wallace State Community College	Selma
	Jacksonville State University	Jacksonville
	Jefferson Davis State Junior College	Brewton
	Jefferson State Junior College	Birmingham
	John C. Calhoun State Community College	Decatur
	Judson College	Marion
	Livingston University	Livingston
	Lawson State Community College	Birmingham
	Lurleen B. Wallace State Junior College	Andalusia
	Marion Military Institute	Marion
	Miles College	Birmingham
	Mobile College	Mobile
	Northeast Alabama State Junior College	Rainsville
	Northwest Alabama State Junior College	Phil Campbell
	Oakwood College	Huntsville
	Samford University	Birmingham
	Selma University	Selma
	Snead State Junior College	Boaz
	Southeastern Bible College	Birmingham
	Southern Benedictine College	Saint Bernard
	Southern Union State Junior College	Wadley
	Spring Hill College	Mobile
	Stillman College	Tuscaloosa
	Talladega College	Talladega
	Troy State University	Troy
	Tuskeegee Institute	Tuskeegee Institute
	University of Alabama	University
	University of Alabama in Birmingham	Birmingham
	University of Alabama in Huntsville	Huntsville
	University of Montevallo	Montevallo
	University of North Alabama	Florence
	University of South Alabama	Mobile
	Walker College	Jasper
AK	Sheldon Jackson College	Sitka
	University of Alaska-Fairbanks	Fairbanks
	University of Alaska Juneau Senior College	Juneau
AS	American Samoa Community College	Pago Pago
AZ	American Graduate School of International Management	Glendale
	Arizona State University	Tempe
	Arizona Western College	Yuma

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Central Arizona College	Coolidge
	Cochise College	Douglas
	College of Ganado	Ganado
	DeVry Institute of Technology	Phoenix
	Eastern Arizona College	Thatcher
	Grand Canyon College	Phoenix
	Maricopa County Community	
	College System Office	Phoenix
	Glendale Community College	Glendale
	Maricopa Technical Community College	Phoenix
	Mesa Community College	Mesa
	Phoenix College	Phoenix
	Scottsdale Community College	Scottsdale
	Mohave Community College	Kingman
	Navajo Community College	Tsaile
	Northern Arizona University	Flagstaff
	Northland Pioneer College	Holbrook
	Pima Community College	Tucson
	Southwestern College	Phoenix
	University of Arizona	Tucson
	Yavapai College	Prescott
AR	Arkansas College	Batesville
	Arkansas State University-Main Campus	State University
	Arkansas State University-Beebe Branch	Beebe
	Arkansas Tech University	Russellville
	Central Baptist College	Conway
	College of the Ozarks	Clarksville
	Crowley's Ridge College	Paragould
	Garland County Community College	Hot Springs
	Harding College-Main Campus	Searcy
	Henderson State University	Arkadelphia
	Hendrix College	Conway
	John Brown University	Siloam Springs
	Mississippi County Community College	Blytheville
	Quachita Baptist University	Arkadelphia
	Philander Smith College	Little Rock
	Phillips County Community College	Helena
	Southern Arkansas University	Magnolia
	Southern Arkansas University	
	Southwest Technical Institute	East Camden
	Southern Baptist College	Walnut Ridge
	Southern State College	Magnolia
	University of Arkansas-Main Campus	Fayetteville
	University of Arkansas-Little Rock	Little Rock
	University of Arkansas	
	Medical Sciences Campus	Little Rock
	University of Arkansas-Monticello	Monticello
	Westlark Community College	Fort Smith
CA	Allan Hancock College	Santa Maria
	Ambassador College	Pasadena
	American Baptist Seminary of the West-Central Office	Berkeley
	American Baptist Seminary of the West-Covina	Covina
	Armstrong College	Berkeley
	Azusa Pacific College	Azusa
	Bakersfield College	Bakersfield
	Barstow College	Barstow
	Bauder College	Sacramento
	Bethany Bible College	Santa Cruz
	Biola College	La Mirada
	Brooks College	Long Beach

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Brooks Institute of Santa Barbara	Santa Barbara
	Butte College	Oroville
	Cabrillo College	Aptos
	California Baptist College	Riverside
	California College of Arts and Crafts	Oakland
	California Institute of the Arts	Valencia
	California Institute of Asian Studies	San Francisco
	California Institute of Technology	Pasadena
	California Lutheran College	Thousand Oaks
	California Maritime Academy	Vallejo
	California State College-San Bernadino	San Bernardino
	California State College-Stanislaus	Turlock
	California Polytechnic State University-San Luis Obispo	San Luis Obispo
	California State University-Fresno	Fresno
	California State University-Fullerton	Fullerton
	California State University-Hayward	Hayward
	California State University-Long Beach	Long Beach
	California State University-Los Angeles	Los Angeles
	California State University-Sacramento	Sacramento
	San Diego State University	San Diego
	San Jose State University	San Jose
	Cerritos College	Norwalk
	Cerro Coso Community College	Ridgecrest
	Chapman College	Orange
	Christian Heritage College	El Cajon
	Church Divinity School of the Pacific	Berkeley
	Citrus College	Azusa
	Claremont Colleges-System Office	Claremont
	Claremont Men's College	Claremont
	Claremont University Center and Graduate School	Claremont
	Harvey Mudd College	Claremont
	Pitzer College	Claremont
	Pomona College	Claremont
	Scripps College	Claremont
	Coast Community College-System Office	Costa Mesa
	Golden West College	Huntington Beach
	Orange Coast College	Costa Mesa
	Cogswell College	San Francisco
	Colegio De La Tierra	Goshen
	College of the Canyons	Valencia
	College of the Desert	Palm Desert
	College of Marin	Kentfield
	College of Notre Dame	Belmont
	College of the Redwoods	Eureka
	College of the Siskiyous	Weed
	Columbia Junior College	Columbia
	Compton Community College	Compton
	Contra Costa Community College-System Office	
	Diablo Valley College	Pleasant Hill
	Cuesta College	San Luis Obispo
	Cypress College	Cypress
	Dominican College of San Rafael	San Rafael
	El Camino College	Torrance
	Foothill-De Anza Community College District-System Office	Los Altos Hills
	De Anza College	Cupertino
	Foothill College	Los Altos Hills
	Fuller Theological Seminary	Pasadena
	Gavilan College	Gilroy
	Glendale Community College	Glendale
	Golden Gate University	San Francisco
	Grossmont College	El Cajon
	Hartnell College	Salinas
	Holy Family College	Mission San Jose

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Holy Names College	Oakland
	Immaculate Heart College	Los Angeles
	Indian Valley Colleges	Novato
	John F. Kennedy University	Orinda
	Lake Tahoe Community College	S. Lake Tahoe
	Lassen College	Susanville
	LaVerne College	La Verne
	L.I.F.E. Bible College	Los Angeles
	Lincoln University	San Francisco
	Lone Mountain College	San Francisco
	Long Beach City College	Long Beach
	Los Angeles Baptist College	Newhall
	Los Angeles Community College-System Office	Los Angeles
	East Los Angeles College	Los Angeles
	Los Angeles City College	Los Angeles
	Los Angeles Harbor College	Wilmington
	Los Angeles Mission College	San Fernando
	Los Angeles Pierce College	Woodland Hills
	Los Angeles Southwest College	Los Angeles
	Los Angeles Valley College	Van Nuys
	West Los Angeles College	Culver City
	Los Rios Community College-System Office	Sacramento
	Cosumnes River College	Sacramento
	Sacramento City College	Sacramento
	Loyla Marymount University	Los Angeles
	Marymount Palos Verdes College	Rancho Palos Verdes
	Mendocino College	Ukiah
	Menlo College	Menlo Park
	Mennonite Brethren Biblical Seminary	Fresno
	Merced College	Merced
	Mills College	Oakland
	Monterey Institute for Foreign Studies	Monterey
	Monterey Peninsula College	Monterey
	Mount San Antonio College	Walnut
	Mount San Jacinto College	San Jacinto
	Napa College	Napa
	National University	San Diego
	New College of California	San Francisco
	Northrop University	Inglewood
	Occidental College	Los Angeles
	Ohlone College	Fremont
	Otis Art Institute of Los Angeles County	Los Angeles
	Pacific Christian College	Fullerton
	Pacific College	Fresno
	Pacific Oaks College	Pasadena
	Pacific School of Religion	Berkeley
	Pacific Union College	Angwin
	Palomar College	San Marcos
	Palo Verde College	Blythe
	Pasadena City College	Pasadena
	Patten Bible College	Oakland
	Pepperdine University	Malibu
	Peralta Community Colleges-System Office	Oakland
	College of Alameda	Alameda
	Point Loma College	San Diego
	Porterville College	Porterville
	Rand Graduate Institute of Policy Studies	Santa Monica
	Riverside City College	Riverside
	Rosemead Graduate School of Psychology	Rosemead
	Saddleback Community College	Mission Viejo
	Saint Mary's College of California	Moraga

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Saint Patrick's College	Mountain View
	San Diego Community College-Central Office	San Diego
	San Diego Community College-City College	San Diego
	San Diego Community College-Evening College	
	San Francisco Art Institute	San Francisco
	San Francisco Conservatory of Music	San Francisco
	San Francisco Theological Seminary	San Anselmo
	San Joaquin Delta College	Stockton
	San Jose Community College District-	
	Evergreen Valley College	San Jose
	San Jose City College	San Jose
	San Mateo County Community College	
	District-System Office	San Mateo
	Canada College	Redwood City
	College of San Mateo	San Mateo
	Skyline College	San Bruno
	Santa Ana College	Santa Ana
	Santa Barbara City College	Santa Barbara
	Santa Monica College	Santa Monica
	Santa Rosa Junior College	Santa Rosa
	Shasta College	Redding
	Sierra College	Rocklin
	Simpson College	San Francisco
	Solano Community College	Suisun City
	Southern California College	Costa Mesa
	Southern California College of Optometry	Fullerton
	Southwestern University School of Law	Los Angeles
	Stanford University	Stanford
	State Center Community College District	
	Fresno City College	Fresno
	Reedley College	Reedley
	Taft College	Taft
	United States International University	San Diego
	University of California-Berkeley	Berkeley
	University of California-Davis	Davis
	University of California Hastings College of Law	San Francisco
	University of California-Irvine	Irvine
	University of California-Los Angeles	Los Angeles
	University of California-Riverside	Riverside
	University of California-San Francisco	San Francisco
	University of California-Santa Barbara	Santa Barbara
	University of the Pacific	Stockton
	University of Redlands	Redlands
	University of San Diego	San Diego
	University of San Francisco	San Francisco
	University of Santa Clara	Santa Clara
	University of Southern California	Los Angeles
	University of West Los Angeles	Culver City
	Ventura County Community College District	
	Moorpark College	Moorpark
	Oxnard College	Oxnard
	Ventura College	Ventura
	West Coast Bible College	Fresno
	West Coast University Central Office	Los Angeles
	West Coast University Orange County Center	Orange
	Western State University College of Law-Orange County	Fullerton
	Western State University College of Law-San Diego	San Diego
	West Hills College	Coalinga
	Westmont College	Santa Barbara
	West Valley College	Saratoga

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Whittier College	Whittier
	Woodbury University	Los Angeles
	The Wright Institute	Berkeley
	Yuba College	Marysville
CO	Adams State College	Alamosa
	Aims Community College	Greeley
	Arapahoe Community College	Littleton
	Colorado College	Colorado Springs
	Colorado Mountain College-East Campus	Leadville
	Colorado Mountain College-West Campus	Glenwood Springs
	Colorado School of Mines	Golden
	Colorado State University	Fort Collins
	Colorado Technical College	Manitou Springs
	Colorado Women's College	Denver
	Community College of Denver-Auraria Campus	Denver
	Community College of Denver-North Campus	Denver
	Community College of Denver-Red Rocks Campus	Golden
	Conservative Baptist Theological Seminary	Denver
	El Paso Community College	Colorado Springs
	Fort Lewis College	Durango
	Iliff School of Theology	Denver
	Lamar Community College	Lamar
	Loretto Heights College	Denver
	Mesa College	Grand Junction
	Metropolitan State College	Denver
	Morgan Community College	Fort Morgan
	Northeastern Junior College	Sterling
	Ortero Junior College	La Junta
	Regis College	Denver
	Rockmont College	Denver
	Saint Thomas Seminary	Denver
	Trinidad State Junior College	Trinidad
	University of Colorado-Boulder	Boulder
	University of Colorado-Colorado Springs	Colorado Springs
	University of Colorado-Denver	Denver
	University of Denver	Denver
	University of Denver College of Law	Denver
	University of Northern Colorado	Greeley
	University of Southern Colorado	Pueblo
	Western Bible College	Morrison
	Western State College of Colorado	Gunnison
CT	Albertus Magnus College	New Haven
	Annhurst College	Woodstock
	Bridgeport Engineering Institute	Bridgeport
	Connecticut College	New London
	Eastern Connecticut State College	Willimnatic
	Greater Hartford Community College	Hartford
	Hartford State Technical College	Hartford
	Housatonic Regional Community College	Bridgeport
	Mattuck Community College	Waterbury
	Middlesex Community College	Middletown
	Mitchell College	New London
	Mohegan Community College	Norwich
	Northwestern Connecticut Community College	Winsted
	Norwalk Community College	Norwald
	Post Junior College	Waterbury
	Quinebaug Valley Community College	Danielson
	Saint Joseph College	West Hartford

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Thames Valley State Technical College	Norwich
	Trinity College	Hartford
	Tunxis Community College	Farmington
	University of Bridgeport	Bridgeport
	University of Hartford	West Hartford
	University of New Haven	West Haven
	Yale University	New Haven
DE	Delaware State College	Dover
	Delaware Technical and Community College	Dover
	Goldey Beacom College	Wilmington
	University of Delaware	Newark
	Wesley College	Dover
DC	American University	Washington
	Catholic University of America	Washington
	District of Columbia Teachers College	Washington
	Gallaudet College	Washington
	George Washington University	Washington
	Howard University	Washington
	Mount Vernon College	Washington
	Trinity College	Washington
FL	Barry College	Miami
	Brevard Community College	Cocoa
	Broward Community College	Fort Lauderdale
	Central Florida Community College	Ocala
	Chipola Junior College	Marianna
	College of Boca Raton	Boca Raton
	Daytona Beach Community College	Daytona Beach
	Eckerd College	St. Petersburg
	Edison Community College	Fort Meyers
	Embry-Riddle Aeronautical University	Daytona Beach
	Flagler College	St. Augustine
	Florida A & M University	Tallahassee
	Florida Atlantic University	Boca Raton
	Florida College	Temple Terrace
	Florida International University	Miami
	Florida Junior College	Jacksonville
	Florida Keys Community College	Key West
	Florida Southern College	Lakeland
	Florida Technological University	Orlando
	Fort Lauderdale College	Fort Lauderdale
	Gulf Coast Community College	Panama City
	Heed University	Hollywood
	Hillsborough Community College	Tampa
	Indian River Community College	Fort Pierce
	Jacksonville University	Jacksonville
	Jones College	Jacksonville
	Lake City Community College	Lake City
	Lake-Sumter Community College	Leesburg
	Manatee Junior College	Bradenton
	Miami Christian College	Miami
	Miami-Dade Community College	Miami
	North Florida Junior College	Madison
	Nova University	Fort Lauderdale
	Okaloosa-Walton Junior College	Niceville
	Palm Beach Atlantic College	West Palm Beach
	Palm Beach Junior College	Lake Worth
	Pensacola Junior College	Pensacola
	Polk Community College	Winter Haven

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Rollins College	Winter Park
	Saint Johns River Junior College	Palatka
	Saint Leo College	Saint Leo
	Santa Fe Community College	Gainesville
	Seminole Community College	Sanford
	South-Eastern Bible College	Lakeland
	South Florida Junior College	Avon Park
	University of Florida	Gainesville
	University of Miami	Coral Gables
	University of North Florida	Jacksonville
	Warner Southern College	Lake Wales
	Webber College	Babson Park
GA	Abraham Baldwin Agricultural College	Tifton
	Agnes Scott College	Decatur
	Albany Area Vocational Technical School	Albany
	Albany Junior College	Albany
	Albany State College	Albany
	Andrew College	Cuthbert
	Armstrong State College	Savannah
	Atlanta Christian College	East Point
	Atlanta Junior College	Atlanta
	Atlanta University	Atlanta
	Augusta College	Augusta
	Bainbridge Junior College	Bainbridge
	Berry College	Mount Berry
	Brenau College	Gainesville
	Brewton-Parker College	Mount Vernon
	Carroll County Area Vocational-Technical School	Carrollton
	Carver Bible Institute and College	Atlanta
	Clark College	Atlanta
	Clayton Junior College	Morrow
	Columbus College	Columbus
	Dalton Junior College	Dalton
	DeKalb Community College	Clarkston
	Emanuel County Junior College	Swainsboro
	Emory University	Atlanta
	Fort Valley State College	Fort Valley
	Gainesville Junior College	Gainesville
	Georgia College	Milledgeville
	Georgia Institute of Technology	Atlanta
	Georgia Military College	Milledgeville
	Georgia Southern College	Statesboro
	Georgia Southwestern College	Americus
	Georgia State University	Atlanta
	Gordon Junior College	Barnesville
	Kennesaw Junior College	Marietta
	LaGrange College	LaGrange
	Macon Junior College	Macon
	Marietta-Cobb Area Vocational Technical School	Marietta
	Mercer University	Macon
	Mercer University in Atlanta	Atlanta
	Middle Georgia College	Cochran
	Morehouse College	Atlanta
	Moultrie Area Vocational-Technical School	Moultrie
	North Georgia College	Dahlonega
	North Georgia Technical and Vocational School	Clarkesville
	Oglethorpe College	Atlanta
	Pickens Area Vocational-Technical School	Jasper
	Piedmont College	Demorest
	Reinhardt College	Waleska

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Savannah Area Vocational Technical School	Savannah
	Savannah State College	Savannah
	Shorter College	Rome
	South Georgia College	Douglas
	South Georgia Technical and Vocational School	Americus
	Southern Technical Institute	Marietta
	Swainsboro Area Vocational-Technical School	Swainsboro
	Thomas Area Vocational-Technical School	Thomasville
	Tift College	Forsyth
	Toccoa Falls College	Toccoa Falls
	Troup County Area Vocational Technical School	LaGrange
	Truett McConnell College	Cleveland
	University of Georgia	Athens
	Upson County Area Vocational-Technical School	Thomaston
	Valdosta State College	Valdosta
	Valdosta Technical School	Valdosta
	Walker County Area Technical School	Rock Spring
	Waycross-Ware Area Technical School	Waycross
	Wesleyan College	Macon
	West Georgia College	Carrollton
	Young Harris College	Young Harris
HI	Brigham Young University-Hawaii Campus	Laie Oahu
	Chaminade College of Honolulu	Honolulu
	Hawaii Pacific College	Honolulu
	University of Hawaii-Honolulu Community College	Honolulu
	University of Hawaii-Kapiolani Community College	Honolulu
	University of Hawaii-Kauai Community College	Lihue
	University of Hawaii-Leeward Community College	Pearl City
	University of Hawaii-Manoa	Honolulu
	University of Hawaii-Maui Community College	Kahului
	University of Hawaii-Windward Community College	Kaneohe
ID	Boise State University	Boise
	College of Southern Idaho	Twin Falls
	Idaho State University	Pocatello
	North Idaho College	Coeur D'Alene
	Northwest Nazarene College	Nampa
	Ricks College	Rexburg
	University of Idaho	Moscow
IL	Augustana College	Rock Island
	Aurora College	Aurora
	Barat College	Lake Forest
	Belleville Area College	Belleville
	Blackburn College	Carlinville
	Black Hawk College	Moline
	Bradley University	Peoria
	Carl Sandburg College	Galesburg
	Central YMCA Community College	Chicago
	Chicago College of Osteopathic Medicine	Chicago
	Chicago State University	Chicago
	College of DuPage	Glen Ellyn

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	College of Lake County	Grayslake
	College of St. Francis	Joliet
	College of the University of Chicago	Chicago
	Danville Junior College	Danville
	DeLourdes College	Des Plaines
	DePaul University	Chicago
	DeVry Institute of Technology	Chicago
	Eastern Illinois University	Charleston
	Elgin Community College	Elgin
	Elmhurst College	Elmhurst
	Eureka College	Eureka
	George Williams College	Downers Grove
	Governors State University	Park Forest South
	Greenville College	Greenville
	Highland Community College	Freeport
	Illinois Benedictine College	Lisle
	Illinois Central College	East Peoria
	Illinois College	Jacksonville
	Illinois College of Optometry	Chicago
	Illinois College of Podiatric Medicine	Chicago
	Illinois Institute of Technology	Chicago
	Illinois State University	Normal
	Illinois Valley Community College	Oglesby
	Illinois Wesleyan University	Bloomington
	Joliet Junior College	Joliet
	Judson College	Elgin
	Kankakee Community College	Kankakee
	Kendall College	Evanston
	Kishwaukee College	Malta
	Knox College	Galesburg
	Lake Forest College	Evanston
	Lakeland College	Mattoon
	Lewis and Clark Community College	Godfrey
	Lincoln Trail College	Robinson
	Logan (John A.) College	Carterville
	Loyola University of Chicago	Chicago
	MacMurray College	Jacksonville
	McHenry County College	Crystal Lake
	McKendree College	Lebanon
	Meadville Theological School	Lombard
	Millikin University	Decatur
	Moraine Valley Community College	Palos Hills
	National College of Chiropractic	Lombard
	North Central College	Naperville
	Northeastern Illinois University	Chicago
	Northern Baptist Theological Seminary	Lombard
	Northern Illinois University	DeKalb
	Northwestern University	Evanston
	Oakton Community College	Morton Grove
	Olivet Nazarene College	Kankakee
	Olney Central College	Mt. Carmel
	Prairie State Community College	Chicago Heights
	Rockford College	Rockford
	Rock Valley College	Rockford
	Roosevelt University	Chicago
	Rush University, College of Nursing and Allied Health Sciences	Chicago
	Rush University, Rush Medical College	Chicago
	Sangamon State University	Springfield
	Sauk Valley College	Dixon
	Southern Illinois University	Carbondale
	Southern Illinois University	Edwardsville
	Spertus College of Judaica	Chicago
	Spoon River College	Canton
	Springfield College in Illinois	Springfield

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	State Community College of East Saint Louis, Illinois	East St. Louis
	Thornton Community College	South Holland
	Triton College	River Grove
	University of Health Sciences, The Chicago Medical School	Chicago
	University of Illinois at Chicago Circle	Chicago
	University of Illinois at the Medical Center, School of Public Health	Chicago
	University of Illinois at Urbana-Champaign	Urbana-Champaign
	Wabash Valley College	Mt. Carmel
	Waubonsee Community College	Sugar Grove
	Western Illinois University	Macomb
	Wheaton College	Wheaton
	William Rainey Harper College	Palatine
IN	Anderson College	Anderson
	Associated Mennonite Biblical Seminary	Elkhart
	Ball State University	Muncie
	Bethel College	Mishawaka
	Butler University	Indianapolis
	DePauw University	Greencastle
	Earlham College	Richmond
	Franklin College	Franklin
	Goshen College	Goshen
	Grace College	Winona Lake
	Hanover College	Hanover
	Holy Cross Junior College	Notre Dame
	Huntington College	Huntington
	Indiana Central College	Indianapolis
	Indiana Institute of Technology	Fort Wayne
	Indiana State University	Evansville
	Indiana University	Bloomington
	Indiana University-East	Richmond
	Indiana University-Kokomo	Kokomo
	Indiana University-Northwest	Gary
	Indiana University-South Bend	South Bend
	Indiana University-Southeast	New Albany
	Indiana University-Purdue University at Fort Wayne	Fort Wayne
	Indiana Vocational Technical College	Indianapolis
	International Junior College	Fort Wayne
	Manchester College	North Manchester
	Marian College	Indianapolis
	Marion College	Marion
	Oakland College	Oakland City
	Purdue State University	Muncie
	Purdue University	West Lafayette
	Purdue University-Calumet	Calumet
	Purdue University-North Central	Westville
	Rose-Hulman Institute of Technology	Terre Haute
	Saint Joseph's College	Rensselaer
	Saint Mary's College	Notre Dame
	Saint Mary of the Woods College	Saint Mary of the Woods
	Saint Meinard College	St. Meinard
	Taylor University	Upland
	Tri-State University	Angola
	University of Evansville	Evansville
	University of Notre Dame	South Bend
	Valparaiso University	Valparaiso
	Vincennes University	Vincennes
	Wabash College	Crawfordsville

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
IA	Area One Vocational-Technical School	Calmar and Dubuque
	Briar Cliff College	Sioux City
	Central College	Pella
	Clarke College	Dubuque
	Coe College	Cedar Rapids
	Cornell College	Mt. Vernon
	Des Moines Area Community College	Ankeny
	Drake University	Des Moines
	Ellsworth Community College	Iowa Falls
	Grinnell College	Grinnell
	Hawkeye Institute of Technology	Waterloo
	Iowa Central Community College	Fort Dodge
	Iowa Lakes Community College	Estherville
	Iowa State University	Ames
	Iowa Wesleyan College	Mount Pleasant
	Iowa Western Community College	Council Bluffs
	Kirkwood Community College	Cedar Rapids
	Loras College	Dubuque
	Luther College	Decorah
	Marshalltown Community College	Marshalltown
	Marycrest College	Davenport
	Morningside College	Sioux City
	Mount Mercy College	Cedar Rapids
	North Iowa Area Community College	Mason City
	Open Bible College	Des Moines
	Palmer College of Chiropractic	Davenport
	Simpson College	Indianola
	Southeastern Community College	Burlington
	Southwestern Community College	Creston
	University of Dubuque	Dubuque
	University of Dubuque Theological Seminary	Dubuque
	University of Iowa	Iowa City
	University of Northern Iowa	Cedar Falls
	Upper Iowa University	Fayette
	Wartburg College	Waverly
	Wartburg Seminary	Dubuque
	Westmar College	LeMars
	Western Iowa Technical Community College	Sioux City
KS	Allen County Community Junior College	Iola
	Baker University	Baldwin
	Barton County Community College	Great Bend
	Benedictine College	Atchison
	Bethel College	North Newton
	Central College	McPherson
	Cloud County Community College	Concordia
	Coffeyville Community Junior College	Coffeyville
	Colby Community College	Colby
	Cowley County Community College	Arkansas City
	Dodge City Community College	Dodge City
	Donnelly College	Kansas City
	Emporia Kansas State College	Emporia
	Fort Hays Kansas State College	Hays
	Fort Scott Community College	Fort Scott
	Friends Bible College	Haviland
	Garden City Community College	Garden City
	Haskell Indian Junior College	Lawrence
	Hesston College	Hesston
	Highland Community Junior College	Highland
	Hutchinson Community Junior College	Hutchinson
	Independence Community Junior College	Independence
	Johnson County Community College	Overland Park
	Kansas City Community College	Kansas City

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Kansas Newman College	Wichita
	Kansas State College of Pittsburg	Pittsburg
	Kansas State University	Manhattan
	Kansas Technical Institute	Salina
	Kansas Wesleyan	Salina
	Labette Community Junior College	Parsons
	Manhattan Christian College	Manhattan
	Marymount College of Kansas	Salina
	McPherson College	McPherson
	Mid-America Nazarene College	Olathe
	Neosho County Community Junior College	Chanute
	Ottawa University	Ottawa
	Pratt Community College	Pratt
	Saint John's College	Winfield
	Saint Mary College	Leavenworth
	Saint Mary of the Plains College	Dodge City
	Seward County Community College	Liberal
	Southwestern College in Kansas	Winfield
	Sterling College	Sterling
	Tabor College	Hillsboro
	The University of Kansas	Lawrence
	Washburn University of Topeka	Topeka
	Wichita State University	Wichita
KY	Alice Lloyd College	Pippa Passes
	Asbury College	Wilmore
	Bellarmine College	Louisville
	Berea College	Berea
	Brescia College	Owensboro
	Campbellsville College	Campbellsville
	Centre College of Kentucky	Danville
	Cumberland College	Williamsburg
	Eastern Kentucky University	Richmond
	Georgetown College	Georgetown
	Jefferson Vocational Regional Office	Jeffersontown
	Kentucky Christian College	Grayson
	Kentucky State University	Frankfort
	Kentucky Wesleyan College	Owensboro
	Lees Junior College	Jackson
	Lindsey Wilson College	Columbia
	Midway College	Midway
	Morehead State University	Morehead
	Murray State University	Murray
	Pikeville College	Pikeville
	Saint Catharine College	Saint Catharine
	Southeastern Christian College	Winchester
	Sue Bennett College	London
	Thomas More College	Fort Mitchell
	Transylvania University	Lexington
	University of Kentucky	Lexington
	University of Kentucky Community College System	Lexington
	University of Louisville	Louisville
	Western Kentucky University	Bowling Green
LA	Bossier Parish Community College	Bossier City
	Centenary College of Louisiana	Shreveport
	Delgado College	New Orleans
	Dillard University	New Orleans
	Grambling State University	Grambling
	Louisiana State University-Central Office	Baton Rouge

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Louisiana State University and Agricultural and Mechanical College at Baton Rouge	Baton Rouge
	Louisiana State University-Alexandria	Alexandria
	Louisiana State University-Eunice	Eunice
	Louisiana State University-Shreveport	Shreveport
	University of New Orleans	New Orleans
	Louisiana Tech University	Ruston
	McNeese State University	Lake Charles
	New Orleans Baptist Theological Seminary	New Orleans
	Northeast Louisiana University	Monroe
	Northwestern State University of Louisiana	Natchitoches
	Notre Dame Seminary School of Theology	New Orleans
	Our Lady of Holy Cross College	New Orleans
	Saint Bernard Parish Community College	Chalmette
	Saint Joseph Seminary College	Saint Benedict
	Saint Mary's Dominican College	New Orleans
	Southern University in New Orleans	New Orleans
	Tulane University of Louisiana	New Orleans
	Xavier University of Louisiana	New Orleans
ME	Bowdoin College	Brunswick
	Colby College	Waterville
	College of the Atlantic	Bar Harbor
	Eastern Maine Vocational and Technical Institute	Bangor
	Maine Maritime Academy	Castine
	Nasson College	Springvale
	South Maine Vocational and Technical Institute	South Portland
	Unity College	Unity
	University of Maine at Orono	Orono
MD	Bowie State College	Bowie
	Catonsville Community College	Catonsville
	Charles County Community College	La Plata
	Chesapeake College	Wye Mills
	Columbia Union College	Takoma Park
	Community College of Baltimore	Baltimore
	Dundalk Community College	Baltimore
	Essex Community College	Baltimore County
	Garrett Community College	McHenry
	Goucher College	Towson
	Hagerstown Junior College	Hagerstown
	Harford Community College	Bel Air
	Hood College	Frederick
	Howard Community College	Columbia
	Johns Hopkins University	Baltimore
	Loyola College	Baltimore
	Montgomery College	Rockville
	Saint John's College	Annapolis
	Saint Mary's College of Maryland	Saint Mary's City
	Towson State College	Baltimore
	University of Baltimore	Baltimore
	University of Maryland	College Park
	Villa Julie College	Stevenson
	Washington College	Chestertown

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
MA	Amherst College	Amherst
	Anna Maria College	Paxton
	Assumption College	Worcester
	Bay Path Junior College	Longmeadow
	Bentley College	Waltham
	Boston College	Chestnut Hill
	Boston University	Boston
	Gordon College	Wenham
	Hampshire College	Amherst
	Harvard University	Cambridge
	Lasell Junior College	Auburndale
	Lesley College	Cambridge
	Massachusetts Institute of Technology	Cambridge
	Merrimack College	North Andover
	Mount Holyoke College	South Hadley
	Nichols College	Dudley
	Northeastern University	Boston
	Regis College	Weston
	Simon's Rock	Great Barrington
	Smith College	Northampton
	Southeastern Massachusetts University	North Darmouth
	Springfield College	Springfield
	Springfield Technical Community College	Springfield
	Stonehill College	North Easton
	Suffolk University	Boston
	Tufts University	Medford
	University of Massachusetts	Boston
	Wentworth Institute	Boston
	Wheelock College	Boston
	Williams College	Williamstown
	Worcester Junior College	Worcester
	Worcester Polytechnic Institute	Worcester
MI	Alma College	Alma
	Alpena Community College	Alpena
	Andrews University	Berrien Springs
	Aquinas College	Grand Rapids
	Bay de Noc Community College	Escanaba
	Calvin College	Grand Rapids
	Calvin Theological Seminary	Grand Rapids
	Central Michigan University	Mount Pleasant
	Concordia Lutheran Junior College	Ann Arbor
	Delta College	University Center
	Detroit Institute of Technology	Detroit
	Eastern Michigan University	Ypsilanti
	Ferris State College	Big Rapids
	General Motors Institute	Flint
	Grace Bible College	Wyoming
	Grand Rapids Baptist College	Grand Rapids
	Grand Rapids Junior College	Grand Rapids
	Grand Valley State College	Allendale
	Highland Park Community College	Highland Park
	Hillsdale College	Hillsdale
	Hope College	Holland

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Jackson Community College	Jackson
	Kalamazoo College	Kalamazoo
	Kalamazoo Valley Community College	Kalamazoo
	Kirtland Community College	Roscommon
	Lake Michigan College	Benton Harbor
	Lake Superior State College	Saulte Ste. Marie
	Lansing Community College	Lansing
	Macomb County Community College	Warren
	Madonna College	Livonia
	Marygrove College	Detroit
	Mercy College of Detroit	Detroit
	Merrill-Palmer Institute	Detroit
	Michigan Department of Education-Environmental Guidelines	Lansing
	Michigan State University	East Lansing
	Michigan Technological University	Houghton
	Mid Michigan Community College	Harrison
	Monroe County Community College	Monroe
	Montcalm Community College	Sidney
	Mott Community College	Flint
	Muskegon Business College	Muskegon
	Muskegon Community College	Muskegon
	Northern Michigan University	Marquette
	Northwestern Michigan College	Traverse City
	Oakland Community College	Bloomfield Hills
	Oakland University	Rochester
	Olivet College	Olivet
	Saginaw Valley State College	University Center
	Saint Mary's College	Orchard Lake
	Schoolcraft College	Livonia
	Shaw College at Detroit	Detroit
	Southwestern Michigan College	Dowagiac
	Spring Arbor College	Spring Arbor
	Suomi College	Hancock
	University of Detroit	Detroit
	University of Michigan	Ann Arbor
	Walsh College	Troy
	Washtenaw Community College	Ann Arbor
	Wayne County Community College	Detroit
	Wayne State University	Detroit
	Western Michigan University	Kalamazoo
	West Shore Community College	Scottville
	Western Theological Seminary	Holland
MN	Anoka-Ramsey Community College	Coon Rapids
	Augsburg College	Minneapolis
	Austin Community College	Austin
	Bemidji State University	Bemidji
	Bethany Lutheran College	Mankato
	Brainerd Community College	Brainerd
	Carleton College	Northfield
	College of Saint Benedict	St. Joseph
	College of St. Catherine	St. Paul
	College of St. Scholastica	Duluth
	College of St. Thomas	St. Paul
	Concordia College	Moorhead
	Crosier Seminary Junior College	Onamia
	Dr. Martin Luther College	New Ulm
	Fergus Falls Community College	Fergus Falls
	Hibbing Community College	Hibbing
	Itasca Community College	Grand Rapids
	Lakewood Community College	White Bear Lake
	Luther Theological Seminary	St. Paul
	Macalester College	St. Paul
	Mankato State University	Mankato

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Mesabi Community College	Virginia
	Metropolitan Community College	Minneapolis
	Metropolitan State University	St. Paul
	Minneapolis College of Art and Design	Minneapolis
	Minnesota Bible College	Rochester
	Moorhead State College	Moorhead
	Normandale Community College	Bloomington
	North Hennepin Community College	Minneapolis
	Northland Community College	Thief River Falls
	Northwestern College	Roseville
	Rainy River Community College	International Falls
	Rochester Community College	Rochester
	Saint John's University	Collegeville
	Saint Mary's College	Winona
	Southwest Minnesota State College	Marshall
	St. Cloud Area Vocational Technical Institute	St. Cloud
	St. Cloud State University	St. Cloud
	St. Mary's Junior College	Minneapolis
	St. Paul Bible College	Bible College
	United Theological Seminary of the Twin Cities	New Brighton
	University of Minnesota	Minneapolis
	Vermilion Community College	Ely
	William Mitchell College of Law	St. Paul
	Winona State University	Winona
	Worthington Community College	Worthington
MS	Alcorn State University	Lorman
	Belhaven College	Jackson
	Clarke College	Newton
	Coahoma Junior College	Clarksdale
	Copiah-Lincoln Junior College	Wesson
	Delta State University	Cleveland
	East Central Junior College	Decatur
	East Mississippi Junior College	Scooba
	Hinds Junior College	Raymond
	Holmes Junior College	Goodman
	Itawamba Junior College	Fulton
	Jackson State University	Jackson
	John C. Stennis Vocational Complex	Dekalb
	Jones County Junior College	Ellisville
	Mary Holmes College	West Point
	Meridian Junior College	Meridian
	Millsaps College	Jackson
	Mississippi College	Clinton
	Mississippi Delta Junior College	Moorhead
	Mississippi Gulf Coast Junior College	Perkinston
	Mississippi Industrial College	Holly Springs
	Mississippi State University	Mississippi State
	Mississippi University for Women	Columbus
	Northeast Mississippi Junior College	Booneville
	Northwest Mississippi Junior College	Senatobia
	Pearl River Junior College	Poplarville
	Rust College	Holly Springs
	Southwest Mississippi Junior College	Summit
	Tougaloo College	Tougaloo
	University of Mississippi	University
	University of Mississippi Medical Center	Jackson
	University of Southern Mississippi	Hattiesburg
	Utica Junior College	Utica
	Wesley College	Florence
	William Carey College	Hattiesburg
	Wood Junior College	Mathiston

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
MO	Assemblies of God Graduate School	Springfield
	Avila College	Kansas City
	Calvary Bible College	Kansas City
	Central Bible College	Springfield
	Central Methodist College	Fayette
	Central Missouri State University	Warrensburg
	Columbia College	Columbia
	Concordia Seminary	St. Louis
	Cottey College	Nevada
	Crowder College	Neosho
	Culver-Stockton College	Canton
	Fontbonne College	St. Louis
	Hannibal Lagrange College	Hannibal
	Harris Teachers College	St. Louis
	Jefferson College	Hillsboro
	Kansas City Art Institute	Kansas City
	Kansas City College of Osteopathic Medicine	Kansas City
	Logan College of Chiropractic	Chesterfield
	Longview Community College	Kansas City
	Maple Woods Community College	Kansas City
	Maryville College	St. Louis
	Meramec Community College	St. Louis
	Missouri Baptist College	St. Louis
	Missouri Southern State College	Joplin
	Moberly Area Junior College	Moberly
	Northeast Missouri State University	Kirksville
	Northwest Missouri State University	Maryville
	Rockhurst College	Kansas City
	Saint Louis College of Pharmacy	St. Louis
	Saint Louis Community College at Forest Park	St. Louis
	Saint Louis University	St. Louis
	Saint Paul's College	Concordia
	School of the Ozarks	Point Lookout
	Southwest Missouri State University	Springfield
	State Fair Community College	Sedalia
	Stephen's College	Columbia
	Tarkio College	Tarkio
	The Principia	St. Louis
	Three Rivers Community College	Poplar Bluff
	University of Missouri-Columbia	Columbia
	University of Missouri-Kansas City	Kansas City
	University of Missouri-Rolla	Rolla
	University of Missouri-St. Louis	St. Louis
	Washington University	St. Louis
	Water and Wastewater Technical School	Neosho
	Webster College	Webster
	Westminster College	Fulton
	William Jewell College	Kansas City
MT	Carroll College	Helena
	College of Great Falls	Great Falls
	Dawson College	Glendive
	Eastern Montana College	Billings
	Flathead Valley Community College	Kalispell
	Miles Community College	Miles City
	Montana College of Mineral Science and Technology	Butte
	Montana State University	Bozeman
	Northern Montana College	Havre
	Rocky Mountain College	Billings
	University of Montana	Missoula
	Western Montana College	Dillon

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
NE	Central Technical Community College	Hastings
	Chadron State College	Chadron
	College of Saint Mary	Omaha
	Concordia College	Seward
	Creighton University	Omaha
	Dana College	Blair
	Doane College	Crete
	Grace College of the Bible	Omaha
	Hastings College	Hastings
	Kearney State College	Kearney
	McCook Community College	McCook
	Midland Lutheran College	Fremont
	Mid-Plains Community College	North Platte
	Northeast Technical Community College	Norfolk
	Platte Technical Community College	Columbus
	Southeast Community College	Lincoln
	Union College	Lincoln
	University of Mid-America	Lincoln
	University of Nebraska	Lincoln
	Wayne State College	Wayne
NV	University of Nevada-Las Vegas	Las Vegas
	University of Nevada-Reno	Reno
	Clark County Community College	Las Vegas
	Northern Nevada Community College	Elko
	Sierra Nevada College	Incline Village
	Western Nevada Community College	Carson City
NH	Colby-Sawyer College	New London
	Dartmouth College	Hanover
	Franklin Pierce College	Rindge
	New England College	Henniker
	NH Technical Institute	Concord
	NH Voc-Tech College of Berlin	Berlin
	NH Voc-Tech College of Claremont	Claremont
	NH Voc-Tech College of Laconia	Laconia
	NH Voc-Tech College of Manchester	Manchester
	NH Voc-Tech College of Nashua	Nashua
	NH Voc-Tech College of Portsmouth	Portsmouth
	Saint Anselm's College	Manchester
	University of New Hampshire	Durham
	White Pines College	Chester
NJ	Atlantic Community College	Mays Landing
	Bergen Community College	Paramus
	Brookdale Community College	Lincroft
	Burlington County College	Pemberton
	Camden County College	Caldwell
	Centenary College for Women	Hackettstown
	County College of Morris	Dover
	Cumberland County College	Vineland
	Drew University	Madison
	Fairleigh Dickinson University	Rutherford
	Gloucester County College	Sewell
	Kean College of New Jersey	Union
	Mercer County Community College	Trenton
	Middlesex County College	Edison
	Montclair State College	Upper Montclair
	New Jersey Institute of Technology	Newark
	Ocean County College	Toms River
	Passaic County Community College	Paterson
	Princeton University	Princeton

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Rider College	Trenton
	Rutgers the State University	New Brunswick
	Stevens Institute of Technology	Hoboken
	Trenton State College	Trenton
	Union College	Cranford
	Union County Technical Institute	Scotch Plains
	William Paterson College	Wayne
NM	College of the Southwest	Hobbs
	Eastern New Mexico University-Main Campus	Portales
	Eastern New Mexico University-Roswell	Roswell
	New Mexico Highlands University	Las Vegas
	New Mexico Institute of Mining and Technology	Socorro
	New Mexico Junior College	Hobbs
	New Mexico Military Institute	Roswell
	New Mexico State University-Las Cruces	Las Cruces
	New Mexico State University-San Juan	San Juan
	University of Albuquerque	Albuquerque
	University of New Mexico-Main Campus	Albuquerque
NY	Adelphi University	Garden City
	Albany College Pharmacy	Albany
	Albany Law School	Albany
	Alfred University	Alfred
	Bard College	Annandale-on-Hudson
	Bronx Community College	Bronx
	Brooklyn Law School	Brooklyn
	Canisius	Buffalo
	City University of New York	New York
	Clarkson College of Technology	Potsdam
	Colgate University	Hamilton
	College of Mt. Saint Vincent	Riverdale
	College of Saint Rose	Albany
	Columbia University	New York
	Concordia College	Bronxville
	Cornell University	Ithaca
	Dowling College	Oakdale Long Island
	D'Youville College	Buffalo
	Erie Community College	Buffalo
	Hamilton College	Clinton
	Hartwick College	Oneonta
	Hilbert College	Hamburg
	Hobart-William Smith Colleges	Geneva
	Hofstra University	Hempstead
	Houghton College	Houghton
	Hudson Valley Community College	Troy
	Hunter College	New York
	Ithaca College	Ithaca
	King's College	Briarcliff Manor
	Long Island University	Greenvale
	Manhattan College	Bronx
	Medaille College	Buffalo
	Mercy College	Dobbs Ferry
	Molloy College	Rockville Centre
	New School for Social Research	New York
	New York Institute of Technology	Old Westbury
	New York Law School	New York
	Niagara University	Niagara University

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Paul Smith's College of Arts & Science	Paul Smiths
	Polytechnic Institute of New York	Brooklyn
	Rensselaer Polytechnic Institute	Troy
	Roberts Wesleyan College	Rochester
	Rochester Institute of Technology	Rochester
	Rockefeller University	New York
	Saint Bonaventure University	Saint Bonaventure
	Saint John Fisher College	Rochester
	Saint John's University	Jamaica
	Saint Lawrence University	Canton
	Saint Thomas Aquinas College	Sparkhill
	Skidmore College	Saratoga Springs
	Southampton College	Southampton
	State University of New York at Buffalo	Buffalo
	Syracuse University	Syracuse
	The Cooper Union	New York
	Trocaire College	Buffalo
	Ulster County Community College	Stone Ridge
	University of Rochester	Rochester
	Vassar College	Poughkeepsie
	Wagner College	Staten Island
	Webb Institute of Naval Architecture	Glen Cove
	Westchester Community College	Valhalla
NC	Anson Technical Institute	Ansonville
	Appalachian State University	Boone
	Asheville Buncombe Technical Institute	Asheville
	Atlantic Christian College	Wilson
	Beaufort County Technical Institute	Washington
	Belmont Abbey College	Belmont
	Bennett College	Greensboro
	Bladen Technical Institute	Dublin
	Blue Ridge Technical Institute	Flat Rock
	Brevard College	Brevard
	Campbell College	Buies Creek
	Cape Fear Technical Institute	Wilmington
	Carteret Technical Institute	Morehead City
	Catawba College	Salisbury
	Catawba Valley Technical Institute	Hickory
	Central Carolina Technical Institute	Sanford
	Central Piedmont Community College	Charlotte
	Chowan College	Murfreesboro
	Cleveland County Technical Institute	Shelby
	Coastal Carolina Community College	Jacksonville
	College of the Albemarle	Elizabeth City
	Craven Community College	New Bern
	Davidson College	Davidson
	Davidson County Community College	Lexington
	Duke University	Durham
	Durham College	Durham
	East Carolina University	Greenville
	Elon College	Elon College
	Fayetteville State University	Fayetteville
	Fayetteville Technical Institute	Fayetteville
	Gardner Webb College	Boiling Springs
	Gaston College	Dallas
	Greensboro College	Greensboro
	Guilford College	Greensboro
	Guilford Technical Institute	Jamestown
	Halifax Community College	Weldon
	Haywood Technical Institute	Clyde
	High Point College	High Point
	Isothermal Community College	Spindale
	James Sprunt Institute	Kenansville
	Johnson C. Smith University	Charlotte

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Johnston Technical Institute	Smithfield
	Lees-McCrae College	Banner Elk
	Lenoir Community College	Kinston
	Lenoir-Rhyne College	Hickory
	Livingstone College	Salisbury
	Louisburg College	Louisburg
	Mars Hill College	Mars Hill
	Martin Community College	Williamston
	Mayland Technical Institute	Spruce Pine
	McDowell Technical Institute	Marion
	Meredith College	Raleigh
	Methodist College	Fayetteville
	Montreat-Anderson College	Montreat
	Mount Olive College	Mount Olive
	Nash Technical Institute	Rocky Mount
	North Carolina Agricultural and Technical State University	Greensboro
	North Carolina Central University	Durham
	North Carolina State University	Raleigh
	North Carolina Wesleyan College	Rocky Mount
	Pembroke State University	Pembroke
	Pfeiffer College	Misenheimer
	Piedmont Bible College	Winston-Salem
	Piedmont Technical Institute	Roxboro
	Pitt Technical Institute	Greenville
	Queens College	Charlotte
	Randolph Technical Institute	Asheboro
	Richmond Technical Institute	Hamlet
	Roanoke-Chowan Technical Institute	Ahoskie
	Robeson Technical Institute	Lumberton
	Rockingham Community College	Wentworth
	Rowan Technical Institute	Salisbury
	Saint Andrews Presbyterian College	Laurinburg
	Saint Augustine's College	Raleigh
	Saint Mary's College	Raleigh
	Salem College	Winston-Salem
	Sampson Technical Institute	Clinton
	Sandhills Community College	Carthage
	Shaw University	Raleigh
	Stanly Technical Institute	Albermarle
	Surry Community College	Dobson
	Technical Institute of Alamance	Burlington
	Tri-County Technical Institute	Murphy
	University of North Carolina at Chapel Hill	Chapel Hill
	University of North Carolina at Charlotte	Charlotte
	University of North Carolina at Greensboro	Greensboro
	University of North Carolina at Wilmington	Wilmington
	Wake Forest University	Winston-Salem
	Wake Technical Institute	Raleigh
	Warren Wilson College	Swannanoa
	Wayne Community College	Goldsboro
	Western Carolina University	Cullowhee
	Western Piedmont Community College	Morganton
	Wilkes Community College	Wilkesboro
	Wilson County Technical Institute	Wilson
	Wingate College	Wingate
	Winston-Salem State University	Winston-Salem

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
ND	Bismarck Junior College	Bismarck
	Dickinson State College	Dickinson
	Jamestown College	Jamestown
	Lake Region Junior College	Devils Lake
	Mary College	Bismarck
	Mayville State College	Mayville
	Minot State College	Minot
	North Dakota State School of Science	Wahpeton
	North Dakota State University-Main Campus	Fargo
	North Dakota State University-Bottineau	Bottineau
	Trinity Bible Institute	Ellendale
	University of North Dakota-Main Campus	Grand Forks
	University of North Dakota-Williston	Williston
OH	Antioch College	Yellow Springs
	Art Academy of Cincinnati	Cincinnati
	Bluffton College	Bluffton
	Capital University	Columbus
	Case Western Reserve University	Cleveland
	Central Ohio Technical College	Newark
	Central State University	Wilberforce
	Cincinnati Bible College	Cincinnati
	Cincinnati Technical College	Cincinnati
	Clark Technical College	Springfield
	Cleveland Institute of Art	Cleveland
	Cleveland Institute of Music	Cleveland
	Cleveland State University	Cleveland
	College of Mount St. Joseph on the Ohio	Cincinnati
	College of Steubenville	Steubenville
	College of Wooster	Wooster
	Columbus College of Art and Design	Columbus
	Columbus Technical Institute	Columbus
	Cuyahoga Community College	Cleveland
	Davis Junior College	Toledo
	Defiance College	Defiance
	Denison University	Granville
	Franklin University	Columbus
	Hebrew Union College	Cincinnati
	Heidelberg College	Tiffin
	Hiram College	Hiram
	Hocking Technical College	Nelsonville
	Jefferson County Technical Institute	Steubenville
	John Carroll University	Cleveland
	Josephinum College of Liberal Arts	Worthington
	Kent State University	Kent
	Kenyon College	Gambier
	Kettering College of Medical Arts	Kettering
	Lakeland Community College	Mentor
	Lima Technical College	Lima
	Lorain County Community College	Elyria
	Lutheran Theological Seminary	Columbus
	Malone College	Canton
	Marietta College	Marietta
	Marion Technical College	Marion
	Medical College of Ohio	Toledo
	Miami-Jacobs Junior College	Dayton
	Miami University	Oxford
	Mount Union College	Alliance
	Mount Vernon Nazarene College	Mount Vernon
	Muskingum Area Technical College	Zanesville
	Muskingum College	New Concord
	National Training and Operational Technology Center (EPA)	Cincinnati
	North Central Technical College	Mansfield

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Northwest Technical College	Archbold
	Notre Dame College	Cleveland
	Oberlin College	Oberlin
	Ohio Board of Regents-Technical Education Offerings	Columbus
	Ohio Dominican College	Columbus
	Ohio Northern University	Ada
	Ohio State University	Columbus
	Ohio University	Athens
	Ohio Wesleyan University	Delaware
	Owens Technical College	Perrysburg
	Saint John College of Cleveland	Cleveland
	Sinclair Community College	Dayton
	Stark Technical College	Canton
	Tiffin University	Tiffin
	United Theological Seminary	Dayton
	University of Cincinnati	Cincinnati
	University of Dayton	Dayton
	University of Toledo	Toledo
	Urbana College	Urbana
	Washington Technical College	Marietta
	Wittenberg University	Springfield
	Wright State University	Dayton
	Xavier University	Cincinnati
	Youngstown State University	Youngstown
OK	Bacone College	Muskogee
	Bartlesville Weslyan College	Bartlesville
	Bethany Nazarene College	Bethany
	Cameron University	Lawton
	Carl Albert Junior College	Poteau
	Central State University	Edmond
	Claremore Junior College	Claremore
	Connors State College	Warner
	East Central Oklahoma State University	Ada
	Eastern Oklahoma State College	Wilburton
	El Reno Junior College	El Reno
	Hillsdale Free Will Baptist College	Moore
	Midwest Christian College	Oklahoma City
	Murray State College	Tishomingo
	Northeastern Oklahoma Agricultural and Mechanical College	Miami
	Northeastern Oklahoma State University	Tahlequah
	Northern Oklahoma College	Tonkawa
	Northwestern Oklahoma State University	Alva
	Oklahoma Baptist University	Shawnee
	Oklahoma Christian College	Oklahoma City
	Oklahoma City University	Oklahoma City
	Oklahoma Panhandle State University	Goodwell
	Oklahoma School of Business, Accountancy, Law and Finance	Tulsa
	Oklahoma State University-Main Campus	Stillwater
	Oklahoma State University-Oklahoma City	Oklahoma City
	Oral Roberts University	Tulsa
	Oscar Rose Junior College	Midwest City
	Phillips University	Enid
	Saint Gregory's College	Shawnee
	Sayre Junior College	Sayre
	Seminole Junior College	Seminole
	Southeastern Oklahoma State University	Durant
	South Oklahoma City Junior College	Oklahoma City
	Southwestern College	Oklahoma City
	Tulsa Junior College	Tulsa
	University of Oklahoma-Central Office	Norman

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	University of Oklahoma-Health Science Center	Oklahoma City
	University of Science and Arts of Oklahoma	Chickasha
	University of Tulsa	Tulsa
	Western Oklahoma State College	Altus
OR	Blue Mountain Community College	Pendleton
	Chemeketa Community College	Salem
	Clackamas Community College	Oregon City
	Clatsop Community College	Astoria
	Columbia Christian College	Portland
	Concordia College	Portland
	George Fox College	Newberg
	Judson Baptist College	Portland
	Lane Community College	Eugene
	Lewis and Clark College	Portland
	Linfield College	McMinnville
	Linn-Benton Community College	Albany
	Marylhurst Education Center	Marylhurst
	Mount Hood Community College	Gresham
	Multnomah School of the Bible	Portland
	Museum Art School	Portland
	Oregon State Higher Education District	
	Eastern Oregon State College	La Grande
	Oregon College of Education	Monmouth
	Oregon Institute of Technology	Klamath Falls
	Oregon State University	Corvallis
	Portland State University	Portland
	Southern Oregon State College	Ashland
	University of Oregon-Health Sciences Center	Portland
	Pacific University	Forest Grove
	Reed College	Portland
	Southwestern Oregon Community College	Coos Bay
	Treasure Valley Community College	Ontario
	Umpqua Community College	Rosenburg
	University of Portland	Portland
	Warner Pacific College	Portland
	Western Baptist Bible College	Salem
	Western Conservative Baptist Seminary	Portland
	Western Evangelical Seminary	Portland
	Williamette University	Salem
PA	Allegheny College	Meadville
	Allentown College of St. Francis De Sales	Center Valley
	Alliance College	Cambridge Springs
	Beaver College	Glenside
	Bloomsburg State College	Bloomsburg
	Bucks County Community College	Newton
	Butler County Community College	Butler
	Cabrini College	Radnor
	California State College	California
	Carlow College	Pittsburgh
	Carnegie-Mellon University	Pittsburgh
	Cedar Crest College	Allentown
	Chestnut Hill College	Philadelphia
	Cheyney State College	Cheyney
	Clarion State College	Clarion
	Community College of Allegheny County	Pittsburgh
	Community College of Beaver County	Monaca
	Community College of Philadelphia	Philadelphia
	Delaware Valley College of Science and Agriculture	Doylestown

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Dickinson College	Carlisle
	Drexel University	Philadelphia
	The Dropsie University	Philadelphia
	Duquesne University	Pittsburgh
	Eastern College	Saint Davids
	East Stroudsburg State College	East Stroudsburg
	Edinboro State College	Edinboro
	Franklin-Marshall College	Lancaster
	Gannon College	Erie
	Geneva College	Beaver Falls
	Gettysburg College	Gettysburg
	Gwynedd-Mercy College	Gwynedd Valley
	Harcum Junior College	Bryn Mawr
	Haverford College	Haverford
	Indiana University of Pennsylvania	Indiana
	Juniata College	Huntingdon
	Keystone Junior College	La Plume
	King's College	Wilkes-Barre
	Lafayette College	Easton
	La Roche College	Allison Park
	La Salle College	Philadelphia
	Lehigh University	Bethlehem
	Lincoln University	Lincoln University
	Lock Haven State College	Lock Haven
	Lycoming College	Williamsport
	Mansfield State College	Mansfield
	Marywood College	Scranton
	Mercyhurst College	Erie
	Millersville State College	Millersville
	Montgomery County Community College	Blue Bell
	Northeastern Christian Junior College	Villanova
	Pennsylvania State University	University Park
	Philadelphia College of Pharmacy and Science	Philadelphia
	Point Park College	Pittsburgh
	Reading Area Community College	Reading
	Saint Fidelis College	Herman
	Saint Francis College	Loretto
	Saint Joseph's College	Philadelphia
	Saint Vincent College	Latrobe
	Seton Hill College	Greensburg
	Slippery Rock State College	Slippery Rock
	Spring Garden College	Chestnut Hill
	Susquehanna University	Selinsgrove
	Swarthmore College	Swarthmore
	Temple University	Philadelphia
	University of Pennsylvania	Philadelphia
	University of Pittsburg	Pittsburgh
	University of Scranton	Scranton
	Ursinus College	Collegeville
	Villa Maria College	Erie
	Villanova University	Villanova
	Waynesburg College	Waynesburg
	West Chester State College	West Chester
	Westminster College	New Wilmington
	Widener College	Chester
	Wilkes College	Wilkes-Barre
	Williamsport Area Community College	Williamsport
	Wilson College	Chambersburg
PR	Inter American University of Puerto Rico	San German
	The Catholic University of Puerto Rico	Ponce
	University of Puerto Rico	Mayaguez
	University of Puerto Rico	Rio Pedras

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
RI	Brown University	Providence
	Providence College	Providence
	Roger Williams College	Bristol
	University of Rhode Island	Kingston
SC	Aiken Technical Education Center	Aiken
	Baptist College	Charleston
	Bob Jones University	Greenville
	Central Wesleyan College	Central
	Citadel Military College of South Carolina	Charleston
	Claflin College	Orangeburg
	Clemson University	Clemson
	Coastal Carolina College	Conway
	Coker College	Hartsville
	College of Charleston	Charleston
	Columbia College	Columbia
	Columbia Bible College	Columbia
	Converse College	Spartanburg
	Erskine College	Due West
	Florence-Darlington Technical College	Florence
	Francis Marion College	Florence
	Furman University	Greenville
	Greenville Technical College	Greenville
	Lander College	Greenwood
	Limestone College	Gaffney
	Morris College	Sumter
	Newberry College	Newberry
	North Greenville College	Tigerville
	Orangeburg-Calhoun Technical College	Orangeburg
	Piedmont Technical College	Greenwood
	South Carolina State College	Orangeburg
	Sumter Area Technical College	Sumter
	Tri County Technical College	Pendleton
	Trident Technical College	North Charleston
	University of South Carolina	Columbia
	University of South Carolina at Aiken	Aiken
	University of South Carolina at Beaufort	Beaufort
	University of South Carolina at Spartanburg	Spartanburg
	University of South Carolina at Union	Union
	Voorhees College	Denmark
	Winthrop College	Rock Hill
	Wofford College	Spartanburg
SD	Augustana College	Sioux Falls
	Black Hills State College	Spearfish
	Dakota Wesleyan University	Mitchell
	Freeman Junior College	Freeman
	National College of Business	Rapid City
	Northern State College	Aberdeen
	Presentation College	Aberdeen
	Sioux Falls College	Sioux Falls
	South Dakota School of Mines and Technology	Rapid City
	South Dakota State University	Brookings
	University of South Dakota-Springfield	Springfield
TN	Aquinas Junior College	Nashville
	Austin Peay State University	Clarksville
	Belmont College	Nashville
	Carson-Newman College	Jefferson City
	Chattanooga State Technical Community College	Chattanooga

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Christian Brothers College	Memphis
	Cleveland State Community College	Cleveland
	Columbia State Community College	Columbia
	Covenant College	Lookout Mountain
	Cumberland College	Lebanon
	David Lipscomb College	Nashville
	Dyersburg State Community College	Dyersburg
	East Tennessee State University	Johnson City
	Fisk University	Nashville
	Freed-Hardeman College	Henderson
	Free Will Baptist Bible College	Nashville
	George Peabody College for Teachers	Nashville
	Hiwassee College	Madisonville
	Jackson State Community College	Jackson
	King College	Bristol
	Knoxville College	Knoxville
	Lambuth College	Jackson
	LeMoyne-Owen College	Memphis
	Martin College	Pulaski
	Memphis State University	Memphis
	Middle Tennessee State University	Murfreesboro
	Milligan College	Milligan College
	Nashville State Technical Institute	Nashville
	Roane State Community College	Harriman
	Shelby State Community College	Memphis
	State Technical Institute at Memphis	Memphis
	Steed College	Johnson City
	Tennessee Technological University	Cookeville
	Tennessee Wesleyan College	Athens
	University of the South	Sewanee
	University of Tennessee	Knoxville
	University of Tennessee Center for Health Sciences	Memphis
	University of Tennessee at Martin	Martin
	University of Tennessee at Nashville	Nashville
	Vanderbilt University	Nashville
	Volunteer State Community College	Gallatin
	Walters State Community College	Morristown
TX	Abilene Christian University	Abilene
	Alvin Community College	Alvin
	Amarillo College	Amarillo
	American Technological University	Killeen
	Angelina College	Lufkin
	Angelo State University	San Angelo
	Austin College	Sherman
	Austin Presbyterian Technological Seminary	Austin
	Baylor College of Dentistry	Dallas
	Baylor College of Medicine	Houston
	Baylor University	Waco
	Bee County College	Beeville
	Blinn College	Brenham
	Brazosport College	Lake Jackson
	Cisco Junior College	Cisco
	Clarendon College	Clarendon
	College of the Mainland	Texas City
	Concordia Lutheran College	Austin
	Cooke County College	Gainesville
	Dallas Bible College	Dallas
	Dallas Christian College	Dallas
	Dallas County Community College District	
	Eastfield College	Mesquite
	El Centro College	Dallas
	Mountain View College	Dallas
	Richland College	Dallas

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Dallas Theological Seminary	Dallas
	Del Mar College	Corpus Christi
	DeVry Institute of Technology	Dallas
	East Texas Baptist College	Marshall
	East Texas State University	Commerce
	El Paso Community College	El Paso
	Frank Phillips College	Borger
	Galveston College	Galveston
	Grayson College	Denison
	Gulf Coast Bible College	Houston
	Hardin-Simmons University	Abilene
	Henderson County Junior College	Athens
	Houston Baptist University	Houston
	Houston Community College	Houston
	Howard College at Big Spring	Big Spring
	Howard Payne University	Brownwood
	Huston-Tillotson College	Austin
	Incarnate Word College	San Antonio
	Jacksonville College	Jacksonville
	Jarvis Christian College	Hawkins
	Kilgore College	Kilgore
	Lamar University	Beaumont
	Laredo Junior College	Laredo
	Lee College	Baytown
	Le Tourneau College	Longview
	Lon Morris College	Jacksonville
	Lubbock Christian College	Lubbock
	McLennan Community College	Waco
	McMurry College	Abilene
	Midland College	Midland
	Midwestern State University	Wichita Falls
	Navarro College	Corsicana
	North Harris County College	Houston
	North Texas State University	Denton
	Odessa College	Odessa
	Our Lady of the Lake University of San Antonio	San Antonio
	Pan American University	Edinburg
	Panola Junior College	Carthage
	Ranger Junior College	Ranger
	Rice University	Houston
	Saint Edward's University	Austin
	Sam Houston State University	Huntsville
	San Antonio College	San Antonio
	San Jacinto College	Pasadena
	Schreiner College	Kerrville
	Southern Bible College	Houston
	Southern Methodist University	Dallas
	South Plains College	Lovelland
	South Texas College of Law	Houston
	Southwestern Assemblies of God College	Waxahachie
	Southwestern Baptist Theological Seminary	Fort Worth
	Southwestern Christian College	Terrell
	Southwestern Union College	Keene
	Southwestern University	Georgetown
	Southwest Texas State University	San Marcos
	Stephen F. Austin State University	Nacogdoches
	Tarleton State University	Stephenville
	Tarrant County Junior College-Northeast Campus	Hurst
	Tarrant County Junior College-Northwest Campus	Fort Worth
	Tarrant County Junior College-South Campus	Fort Worth
	Texarkana College	Texarkana
	Texas A & I University	Kingsville

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Texas A & I University-Corpus Christi	Corpus Christi
	Texas A & I University-Laredo	Laredo
	Texas A & M University-Main Campus	College Station
	Texas A & M University Moody College of Marine Sciences and Maritime Resources	Galveston
	Texas Christian University	Fort Worth
	Texas College	Tyler
	Texas Lutheran College	Seguin
	Texas Southmost College	Brownsville
	Texas State Technical Institute-James Connally Campus	Waco
	Texas State Technical Institute-Mid-Continent Campus	Amarillo
	Texas State Technical Institute-Rio Grande Campus	Harlingen
	Texas Tech University	Lubbock
	Texas Wesleyan College	Fort Worth
	Texas Woman's University	Denton
	Trinity University	San Antonio
	Tyler Junior College	Tyler
	University of Dallas	Irving
	University of Houston-Main Campus	Houston
	University of Houston-Clear Lake City	Houston
	University of Houston-Victoria Campus	Victoria
	University of Texas-Arlington	Arlington
	University of Texas-Austin	Austin
	University of Texas at Dallas	Richardson
	University of Texas-El Paso	El Paso
	University of Texas Health Science Center at Dallas	Dallas
	University of Texas Health Science Center at Houston	Houston
	University of Texas Medical Branch at Galveston	Galveston
	University of Texas-San Antonio	San Antonio
	Vernon Regional Junior College	Vernon
	Victoria College	Victoria
	Weatherford College	Weatherford
	Western Texas College	Snyder
	West Texas State Universtiy	Canyon
	Wharton County Junior College	Wharton
	Wiley College	Marshall
UT	Brigham Young University	Provo
	Stevens Henager College	Ogden
	University of Utah	Salt Lake City
	Utah Higher Education System Office	
	University of Utah	Salt Lake City
	Utah State University	Logan
	Southern Utah State College	Cedar City
	Weber State College	Ogden
	College of Eastern Utah	Price
	Dixie College	Saint George
	Snow College	Ephraim
	Utah Technical College at Salt Lake City	Salt Lake City
	Westminster College	Salt Lake City

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
VT	Champlain College	Burlington
	Johnson State College	Johnson
	Lyndon State College	Lyndonville
	Marlboro College	Marlboro
	Middlebury College	Middlebury
	Norwich University	Northfield
	Saint Michael's College	Winooski
	School for International Training	Brattleboro
	Southern Vermont College	Bennington
	Trinity College	Burlington
	University of Vermont and State Agriculture College	Burlington
	Vermont Institute of Community Involvement	South Burlington
	Vermont Technical College	Randolph Center
	Windham College	Putney
VA	Averett College	Danville
	Bridgewater College	Bridgewater
	College of William and Mary	Williamsburg
	Eastern Mennonite College	Harrisonburg
	Eastern Virginia Medical School	Norfolk
	Emory and Henry College	Emory
	Ferrum College	Ferrum
	Hampton Institute	Hampton
	Institute of Textile Technology	Charlottesville
	J. Sargeant Reynolds Community College	Richmond
	Madison University	Harrisonburg
	Old Dominion University	Norfolk
	Radford College	Radford
	Randolph-Macon College	Ashland
	Randolph-Macon Woman's College	Lynchburg
	Saint Paul's College	Lawrenceville
	University of Virginia	Charlottesville
	Virginia Intermont College	Bristol
	Virginia Military Institute	Lexington
	Virginia Polytechnic Institute and State University	Blacksburg
	Virginia Wesleyan College	Norfolk
	Washington and Lee University	Lexington
	Wytheville Community College	Wytheville
WA	Bellevue Community College	Bellevue
	Big Bend Community College	Moses Lake
	Centralia College	Centralia
	Central Washington State College	Ellensburg
	Clark College	Vancouver
	Columbia Basin Community College	Pasco
	Cornish School of Allied Arts	Seattle
	Eastern Washington State College	Cheney
	Evergreen State College	Olympia
	Fort Steilacoom Community College	Tacoma
	Fort Wright College of the Holy Names	Spokane
	Gonzaga University	Spokane
	Grays Harbor College	Aberdeen
	Green River Community College	Auburn
	Highline Community College	Midway
	Lower Columbia College	Longview
	Lutheran Bible Institute of Seattle	Seattle
	Northwest College of the Assemblies of God	Kirkland
	Olympia Technical Community College	Olympia
	Olympic College	Bremerton
	Pacific Lutheran University	Tacoma
	Peninsula College	Port Angeles

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Seattle Community College District	
	North Seattle Community College	Seattle
	Seattle Community College-Central Campus	Seattle
	Seattle Community College-South Campus	Seattle
	Seattle University	Seattle
	Shoreline Community College	Seattle
	Skagit Valley College	Mount Vernon
	Tacoma Community College	Tacoma
	University of Puget Sound	Tacoma
	Walla Walla College	College Place
	Walla Walla Community College	Walla Walla
	Washington State Community College-District 5	
	Edmonds Community College	Lynnwood
	Everett Community College	Everett
	Washington State Community College-District 17	
	Spokane Falls Community College	Spokane
	Washington State University	Pullman
	Wenatchee Valley College	Wenatchee
	Western Washington State College	Bellingham
	Whatcom Community College	Bellingham
	Whitman College	Walla Walla
	Whitworth College	Spokane
	Yakima Valley College	Yakima
WV	Alderson Broaddus College	Phillippi
	Beckley College	Beckley
	Bethany College	Bethany
	Bluefield State College	Bluefield
	Concord College	Athens
	Davis and Elkins College	Elkins
	Glenville State College	Glenville
	Marshall University	Huntington
	Morris Harvey College	Charleston
	Parkersburg Community College	Parkersburg
	Potomac State College	Keyser
	Salem College	Salem
	West Liberty State College	West Liberty
	West Virginia Institute of Technology	Montgomery
	West Virginia University	Morgantown
	Wheeling College	Wheeling
WI	Alverno College	Milwaukee
	Beloit College	Beloit
	Blackhawk Technical Institute	Janesville
	Cardinal Stritch College	Milwaukee
	Carroll College	Waukesha
	Carthage College	Kenosha
	Concordia College	Milwaukee
	District One Technical Institute	Eau Claire
	Edgewood College	Madison
	Fox Valley Technical Institute	Appleton
	Gateway Technical Institute	Kenosha
	Holy Redeemer College	Waterford
	Institute of Paper Chemistry	Appleton
	Lakeshore Technical Institute	Cleveland
	Lawrence University	Appleton
	Madison Area Technical College	Madison
	Madison Business College	Madison
	Marian College of Fond Du Lac	Fond Du Lac
	Marquette University	Milwaukee
	Mid-State Technical Institute	Wisconsin Rapids
	Milton College	Milton

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Milwaukee Area Technical College	Milwaukee
	Moraine Park Vocational, Technical and Adult Education Institute	Fond Du Lac
	Mount Mary College	Milwaukee
	Mount Senario College	Ladysmith
	Nicolet College and Technical Institute	Rhinelander
	North Central Technical Institute	Wausau
	Northeast Wisconsin Technical Institute	Green Bay
	Northland College	Ashland
	Ripon College	Ripon
	Saint Norbert College	De Pere
	Silver Lake College	Manitowoc
	Southwest Wisconsin Vocational-Technical Institute	Fennimore
	University of Wisconsin-Green Bay	Green Bay
	University of Wisconsin-Madison	Madison
	University of Wisconsin-Milwaukee	Milwaukee
	University of Wisconsin-System Office	Madison
	Viterbo College	La Crosse
	Waukesha County Technical Institute	Pewaukee
	Western Wisconsin Technical Institute	La Crosse
WY	Casper College	Casper
	Eastern Wyoming College	Torrington
	Laramie County Community College	Cheyenne
	Northwest Community College	Powell
	Sheridan College	Sheridan
	University of Wyoming	Laramie
	Western Wyoming Community College	Rock Springs